Virginia Information Technologies Agency

VITA

Conference Report

Enterprise Architecture Division

Gartner
CATALYST
CONFERENCE

www.vita.virginia.gov

At the end of the day, Earth is a single point of failure…

Contents

Gartner Conference

Why attend?

- Real-world take-aways
- Actionable insight and how-to advice across a broad range of technical topics
- Drill-down content and proactive guidance on vendor-neutral and cross-functional technology topics like cloud, DevOps, and big data.
- Considered “the” must-attend event for technical professionals by a plethora of technology publications and leaders throughout the U.S.

Recommended attendees

Architects, Managers, Analysts, Developers, and Planners.

2,400+ attendees	70+ solution providers
430+ sessions	50+ exhibitors

Miscellaneous

Hottest topics requested in Gartner One-on-One Meetings

Cloud Computing	Data Management Strategies
Internet of Things (IoT)	Artificial Intelligence (AI)
Application Development Strategies for Digital Business	

No need for the same person to attend yearly – recommend a different person attend every other year, or the same person attend every third year for maximum impact derived from the conference.

#GartnerCAT

Ideas, statements, and notes in this VITA created report are derived from this Gartner Catalyst conference presentations attended, which explain in more detail the ideas contained within this report.

Gartner Opening Keynote

Architect Your Digital Ecosystem

Overview

Great opening presentation consisting of three Gartner leaders as seen pictured below in their presentation to us:

- Danny Brian – Gartner Vice President, Distinguished Analyst, and Gartner Fellow

- Lori Robinson – Gartner Research Vice President

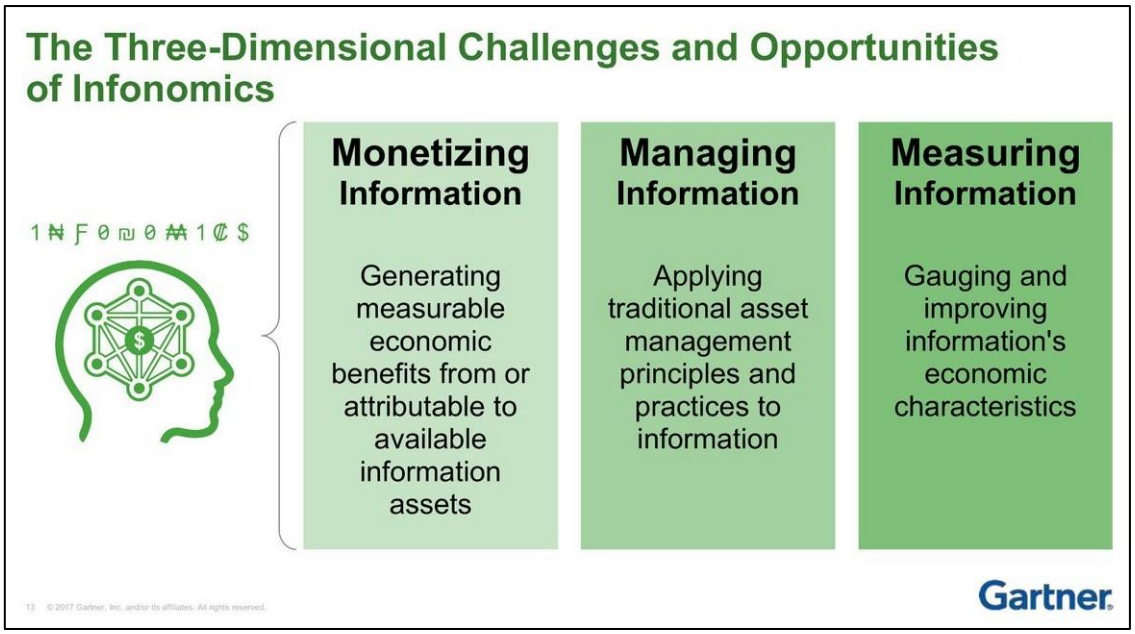
- Kirk Knoernschild – Gartner Chief of Research Vice President and Conference Chair

They discussed topics such as:

Infonomics

How infosavvy are you? Take the quiz: https://surveys.gartner.com/s/InfonomicsBook

infonomics	The emerging discipline of managing and accounting for information with the same or similar rigor and formality as other traditional assets (e.g., financial, physical, intangible, human capital). Infonomics posits that information itself meets all the criteria of formal company assets, and, although not yet recognized by generally accepted accounting practices, increasingly, it is incumbent on organizations to behave as if it were to optimize information's ability to generate business value.



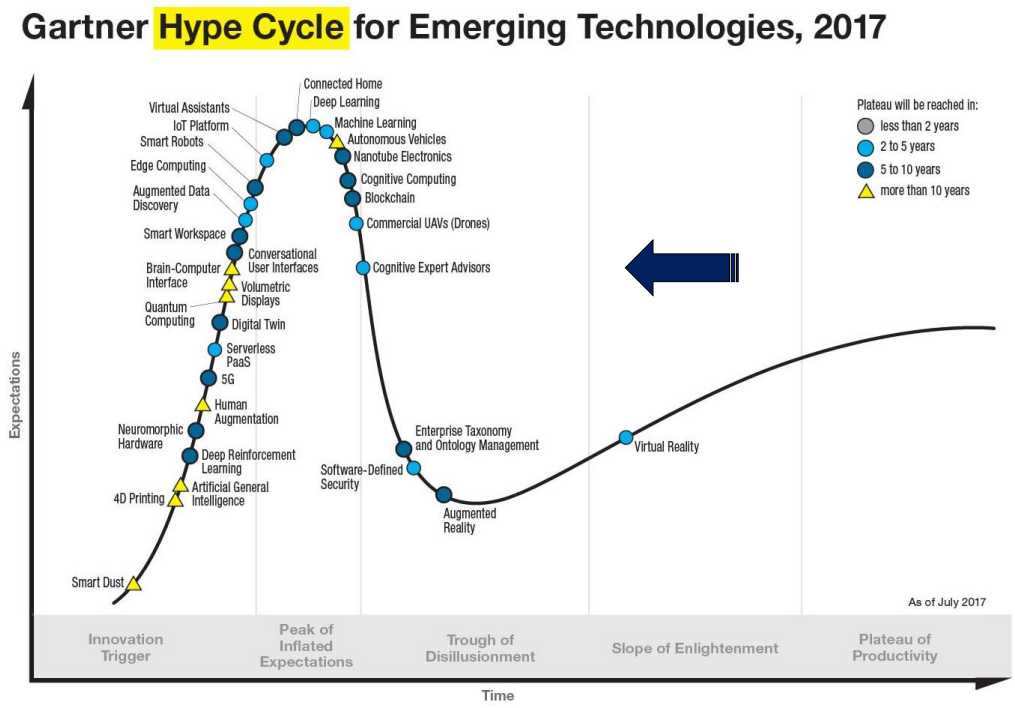
Placement on the Data Science Continuum

We previously wrote about a concept we call the analytics continuum. The continuum provides organizations with a tool to understand their current data science capabilities and what they should consider for next steps. According to the continuum, organizations largely enter the data science market in the following pattern:

Operating in silo's will fail in the future – must have digital ecosystems.

Drones

Drones appeared for the first time in the 2016 Gartner Hype Cycle for Emerging Technologies. Gartner's 2017 graphic follows:



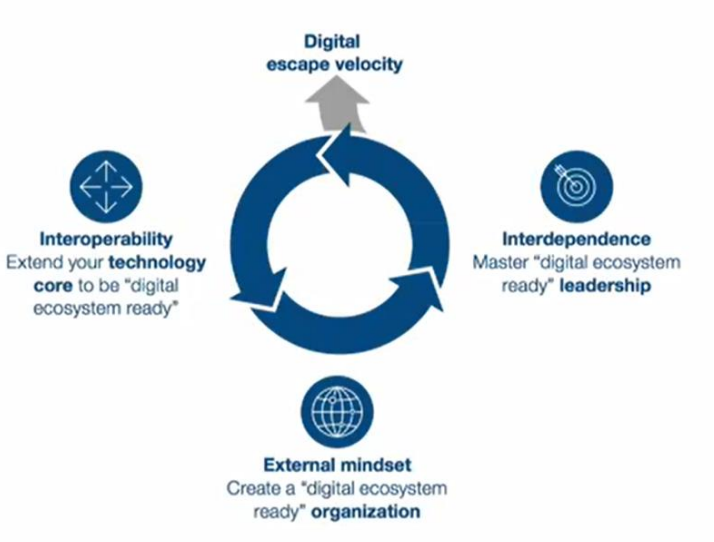
FAA registered drone operators surpassed number of manned aircraft in 2016.

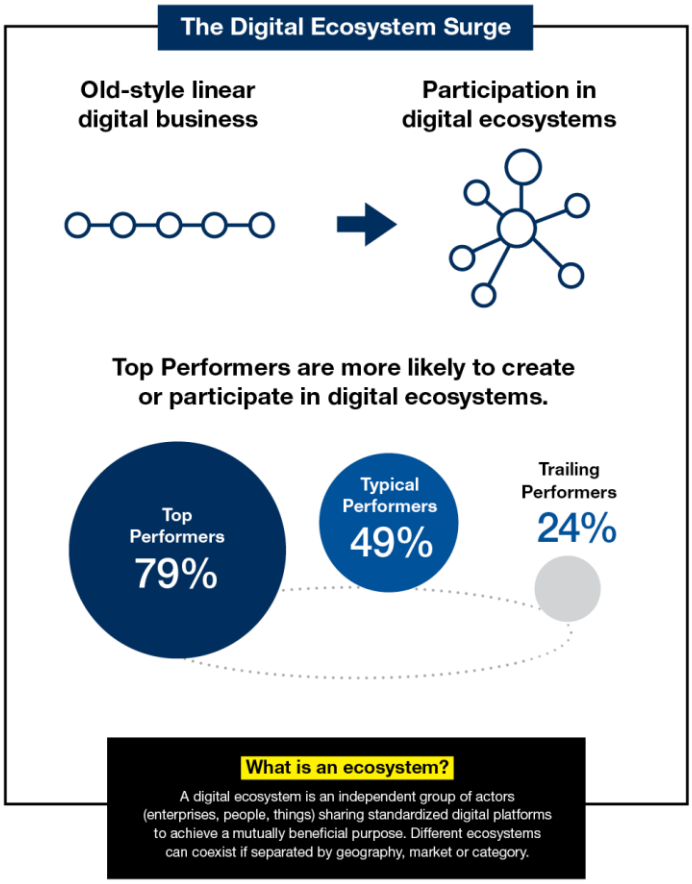
Virginia is 9th out of the top ten drone states per FAA Part-107 licenses issued in 2017 – California is number 1 and Arizona is 10th.

Artificial Intelligence (AI) is driving advances for new intelligent things, such as autonomous vehicles, robots, and drones.

Gartner Opening Keynote

Digital Ecosystems





Gartner Opening Keynote

FAMILYSEARCH™ WHERE GENERATIONS MEET

Ecosystems span multiple spheres of influence and concern spanning such areas as your industry, a grouping of industries, or even society in general.

Ecosystems benefit a lot of different people creating incentives to participate in an ecosystem where people cooperate because they have a mutually beneficial arrangement in addition to the monetary incentives that others will derive through participation.

By 2025, almost one-third of total global sales will come from ecosystems. (McKinsey Analysis 2017 Survey)

We've always had these ecosystems, but digital platforms have enabled creation of new ecosystems and support of existing ecosystems in a much more rapid way.

How do you create an ecosystem?

Used a story from the Genealogy industry to illustrate.

Nobody wants to be a genealogist, but people love to find out about their family history.

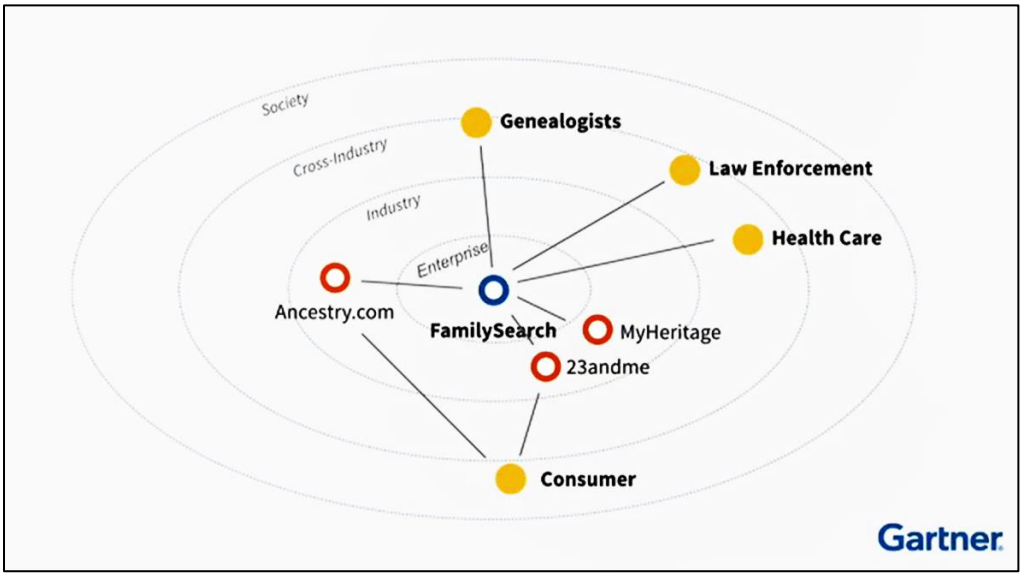
A whole multi-billion dollar industry has popped up only recently because it was a prominent past-time for a lot of people to find out what their family tree looks like.

The key to it all was answering how to get the records of the world to market, make them searchable, and where they're able to connect them into trees where you can aggregate the data into a more useful state, where people can find the information they're searching for.

The answer was the sharing of certain datasets between commercial organizations, non-profit organizations, and volunteer organizations – an ecosystem.

Other industries then popped up around this genealogy ecosystem that popped up because this scenario was mutually beneficial to all the participants.

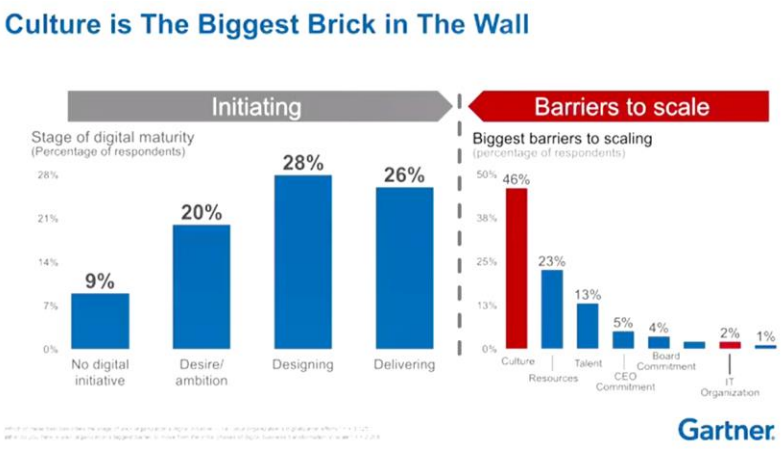
Gartner Opening Keynote



The word Mr. Love identified for what transpired in this ecosystem is: Co-op-e-ti-tion.

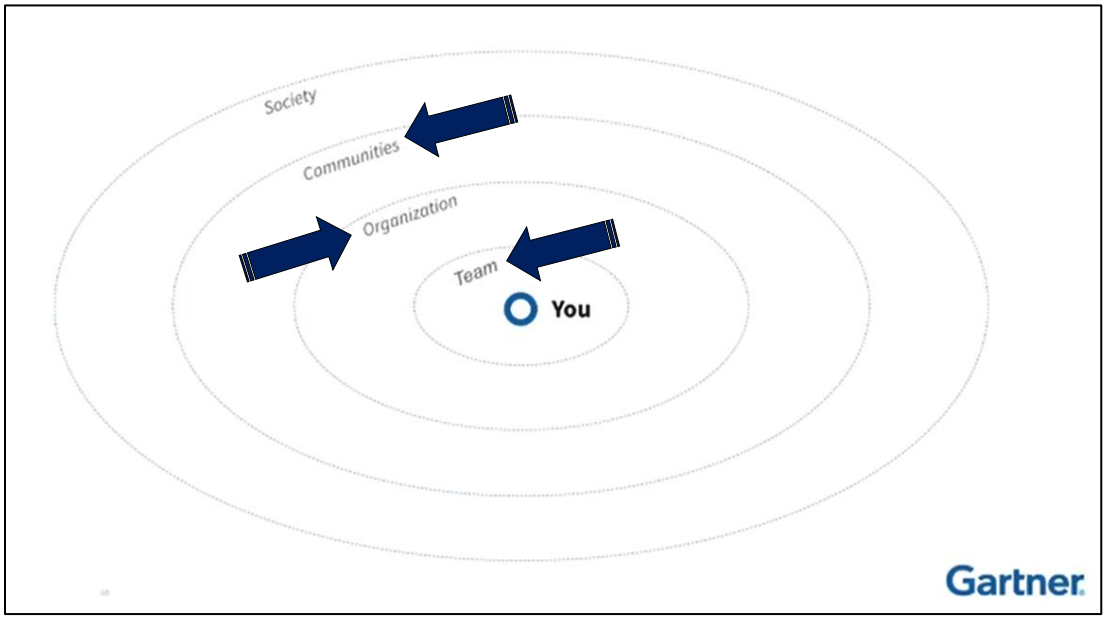
> Coopetition is an ecosystem in which competitors work together on some core and basic things like standards. You choose to compete in other areas, but you're not competing to the point that you're harming the industry. So everyone cooperates on some of the basics, where they're building on common ground and benefitting, which then means this industry grows the opportunity significantly more than if everyone was fighting over every little piece.
>
> ~Ransom H. Love, Founder and former CEO of Caldera, and SVP of Strategic Relations for FamilySearch

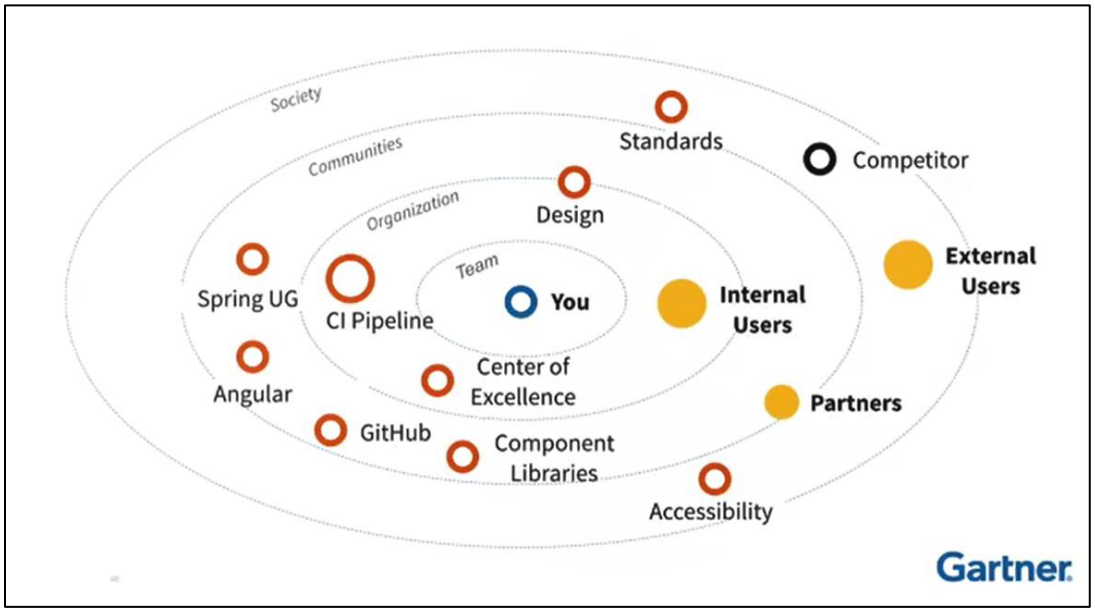
The #1 barrier identified by CEO's for creating digital ecosystems such as the aforementioned genealogy use case is culture, followed by resources and talent. Technology was not cited in the top three barriers.



Gartner Opening Keynote

Culture is not a top-down issue; we the people are the problem in our organizations. IT practitioners have more ability to influence the culture than any top-level leader can in their capacity.





To change your organization's ecosystems, you must change your personal ecosystems.

Danny used the MX corporation example because they have been a huge disruptor in the banking industry and he has a friend, Ryan Moore (Engineer) that works there.

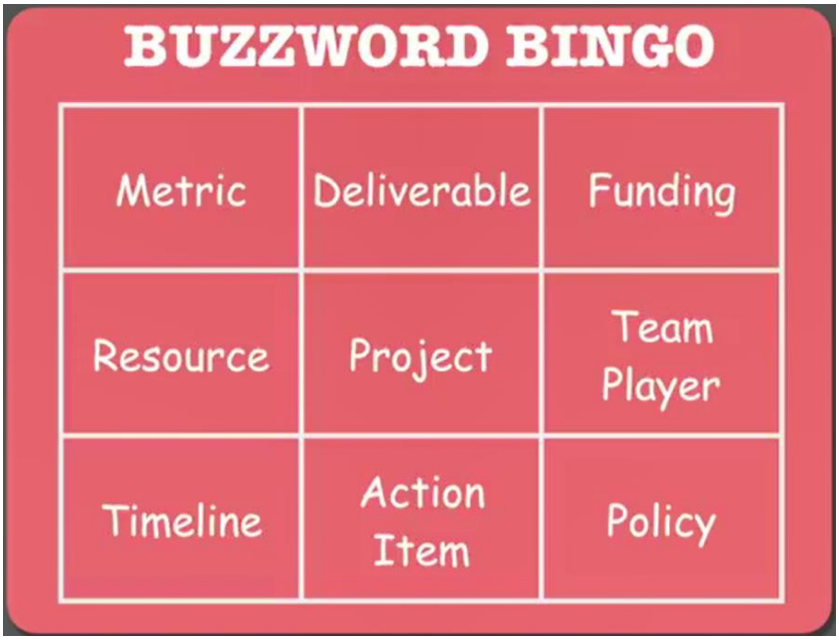
> It's a flat organization with 60 developers in a standup all working for the CTO.
>
> There are no architects although the CTO did architect the overall flat organization ecosystem.
>
> Ryan Moore describes it this way:
>
> > We all sit together, we have a single standup together. There's never any red tape between taking on an issue or a project that goes outside of the team you are on. Last year I was really interested in developing the ability of our company to deploy features targeted at segments of users. I took a look at it and started taking on those tasks, got code reviews from more experienced server-side engineers without having to lobby for a backend engineer or a data engineer to do all that work. In the same way you don't see an ant with an architect hat saying "I've designed the next colony!" Or a bee saying, "This is hive 2.0!" We're

> just down there making the hive work and expanding it the way that it should. An ecosystem is unmanaged in a top to bottom manner. That ecosystem performs in a way that a top-down managed system cannot.

Everyone in that ecosystem is working towards a common goal, which results in an empowering environment. If you can do it, just do it – take the initiative. It's an ecosystem of contributors.

This does not mean everyone everywhere needs to work in a flat organization; there are principles to take away here and apply to your organizations within your spheres of influence.

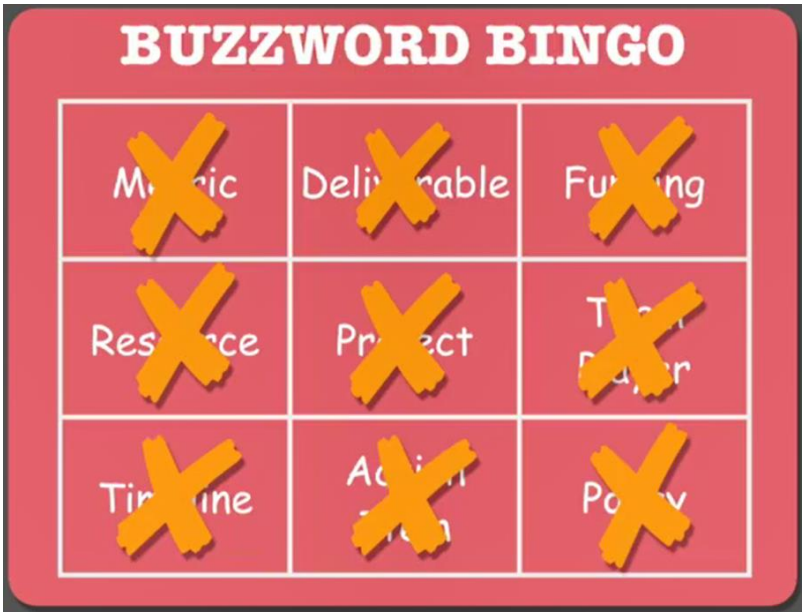
Change the vocabulary in your organization about how you talk about things. Use vocabulary that is freeing, not binding – avoid Buzzword Bingo.



Buzzword Bingo example:

> If we fail to get funding for the proper metrics, the deliverables will suffer due to the lack of resources; projects will fail because we don't

have team players; so we need better policies, more accurate timelines, and better communicated action items.



Organizational processes will focus you on what you know now and do now. But you're more than that, better than that.

We must not let organizational dysfunction be the excuse for our not being the technologist we want to be and paid to be.

Miscellaneous

The biggest roadblock to achieving what is commonly called digital transformation isn't the enabling technology, which can be difficult, rather it is the culture.

- In Gartner's 2018 CIO Survey, 46% of respondents named culture as the biggest barrier to scaling digital transformation.

https://www.gartner.com/smarterwithgartner/learn-the-art-of-culture-hacking-for-culture-change/

Gartner Opening Keynote

The secret behind disruption and redefining analysis for the 21st century is… you:

You detect	You connect	You learn
You evaluate	You innovate	You optimize
You adapt	You dream	You solve
You transform	You lead	You…

Design programs to do only a single thing, but to do it well, and to work together well with other programs. ~Doug McKilroy circa 1990's – Linux

Sounds a bit like microservices doesn't it?

Linux was a major 1990's disrupter – when including Android, Linux is currently the most widely deployed operating system in the world.

IT practitioners must care about digital disruption; it will affect you, if it has not already.

Amazon is the quintessential example of digital disruption.

Built eCommerce platform that has changed the world.

Yearly apparel revenue added since 2005:

Online stores led by Amazon – Up $27.8 Billion

Department stores – Down $29.6 Billion

Example of Farmers Markets, which is a group of individuals, each with different and unique talents, products, and services that come together to create this ecosystem that is greater than the sum of its parts.

IoT enables new decision models and capabilities by pulling edge enterprise and party data together.

Not all decisions are centralized, but the development of new, intelligent decision models are…

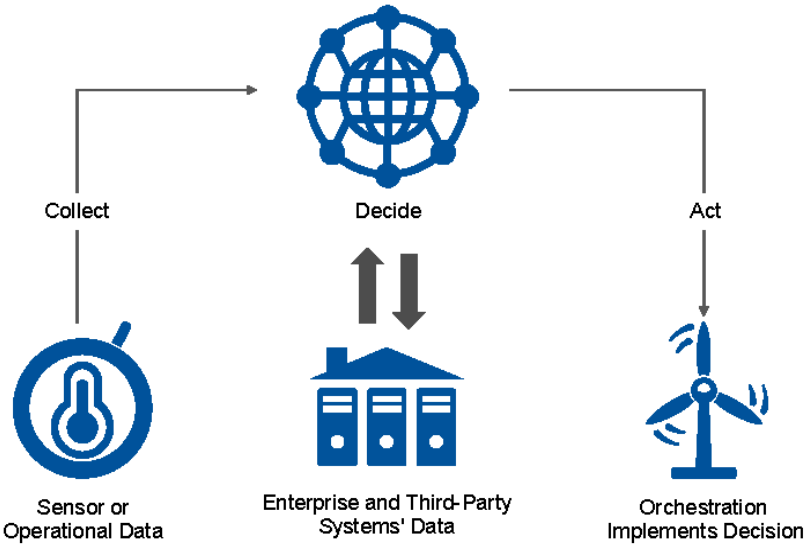
IT is the digital business medium – IoT extends the digital business.

Internet of Things (IoT) Architecture

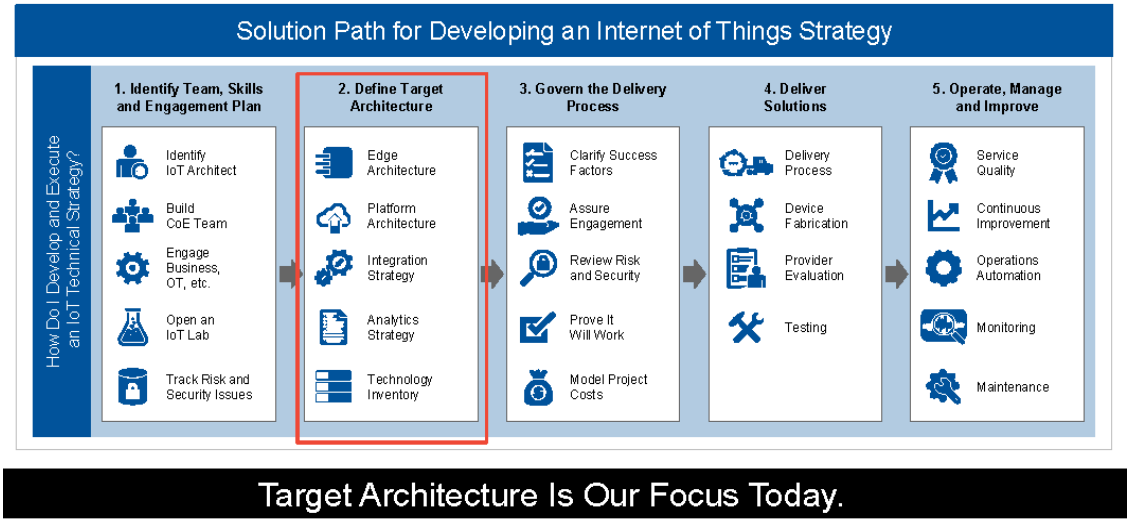
Effective IoT Architecture and Design

Overview

Research and presentation by Mr. Erik T. Heidt of Gartner.



IoT Core Workflow – Gartner 2018



Target Architecture is the Focus Today – Gartner 2018

- Target architecture = (Business decisions) x (IoT architecture)

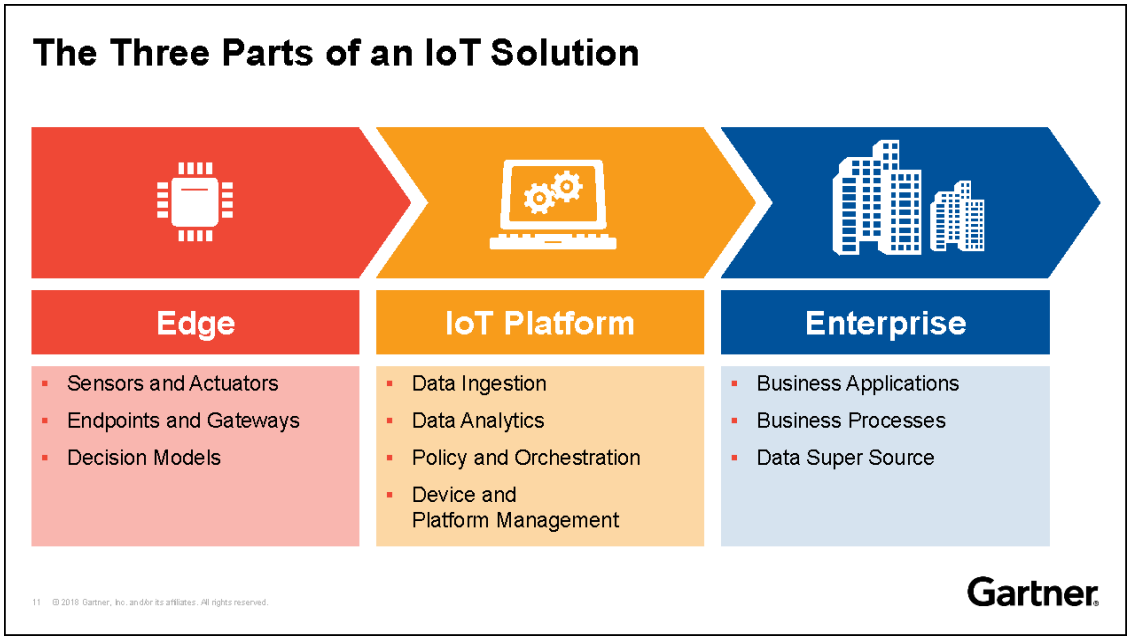
Internet of Things (IoT) Architecture

Begin IoT with the end in mind.

IoT is about business decisions.

Platform is the beating heart of IoT.

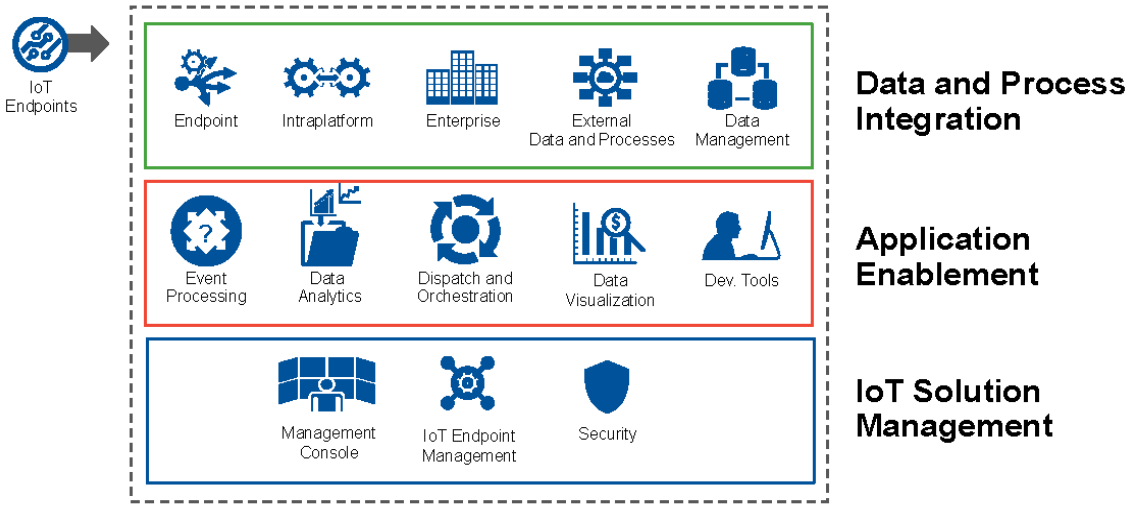
IoT moves from device focused into digital focused.



The Three Parts of an IoT Solution – Gartner 2018

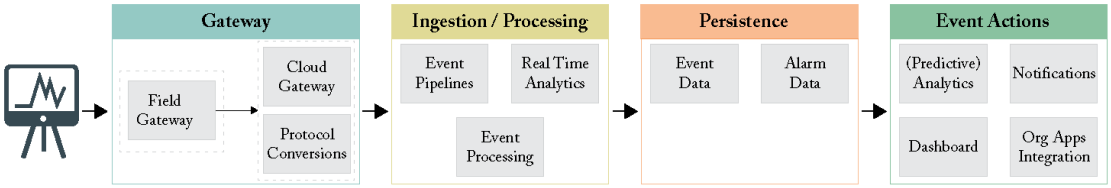
- Shorten time-to-IoT by leveraging existing edge data.
- The cloud is not moving to the edge.
- IoT platform is powerful because it is agile – it is the launchpad, not the rocket.
- IoT has many challenges such as the availability of IoT generalists.
  - Estimated there are currently only around 100 in the U.S.
- Most IoT today is data collection.
  - Embedded computing = microwave, sensors, compute bus; no communication.
- Untapped and silo'd IT is a great opportunity to install IoT.
  - Untapped = has network connection, but is not used.
- HPE has spent billions on edge computing in support of IoT – it's coming.
- Your coding and equipment must be able to handle the meta data of IoT.
- IoT is continuous – not a one-time implementation.
- Enterprise is the "last mile" for IoT.
- IoT is mainly an open loop implementation.
- Business objectives are critical for IoT objectives.

Internet of Things (IoT) Architecture



IoT Platform Reference Architecture – Gartner 2018

IoT refers to a new form of software and service related to device communications. Here devices send across real time data which is analyzed in real time and necessary actions taken based on the analysis. These actions can be anything from email and mobile notifications, to triggering actions within other applications and back onto the devices. Given below is a high level architecture of IoT:



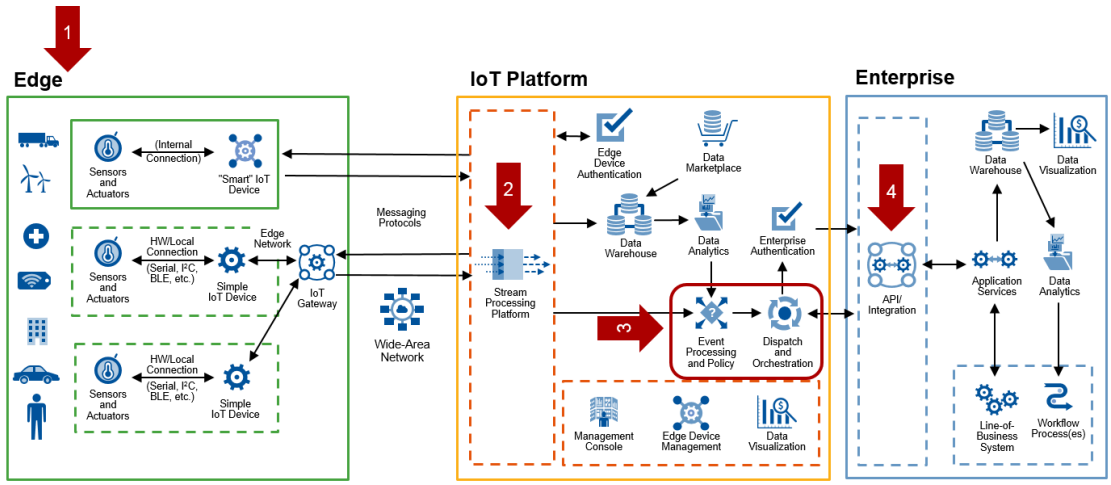
High Level Architecture for IoT

The architecture starts with your devices that will be sending across signals containing data. These signals can be in any form, and generally use binary based proprietary protocols that vary from device to device.

Internet of Things (IoT) by Syntel - Consider IT Done, 2015

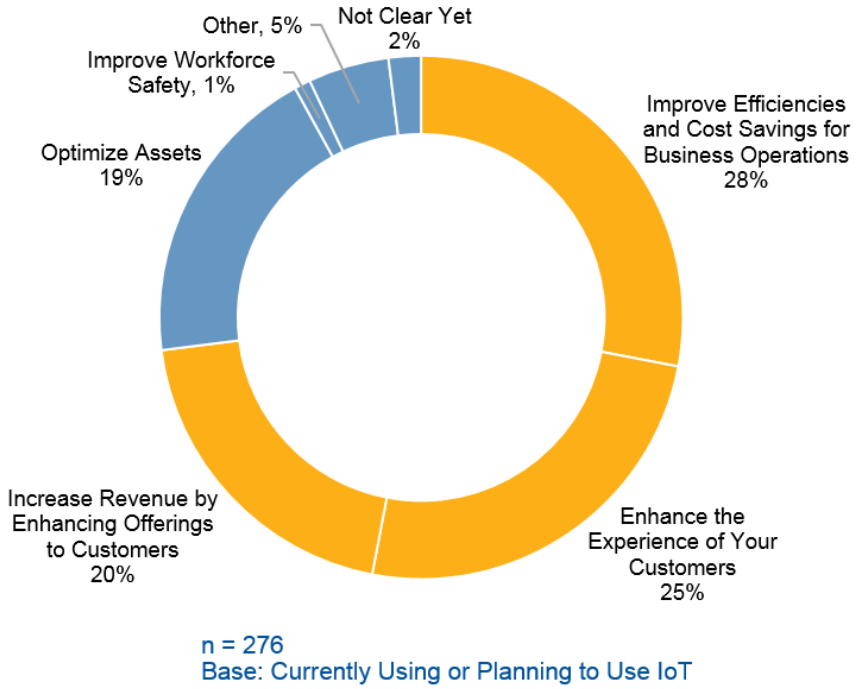
Internet of Things (IoT) Architecture

Figure 4. Logical Architecture for an IoT Solution



Source: Gartner (October 2016)

Figure 2. Business Objectives for Current IoT Projects



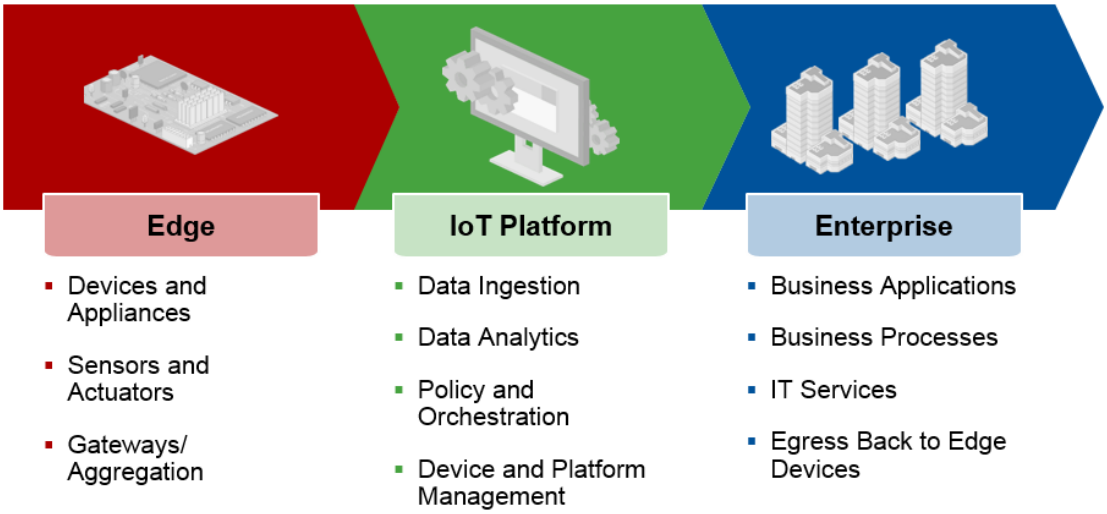
Source: Gartner (October 2016)

Internet of Things (IoT) Architecture

Figure 3. IoT Value Spectrum

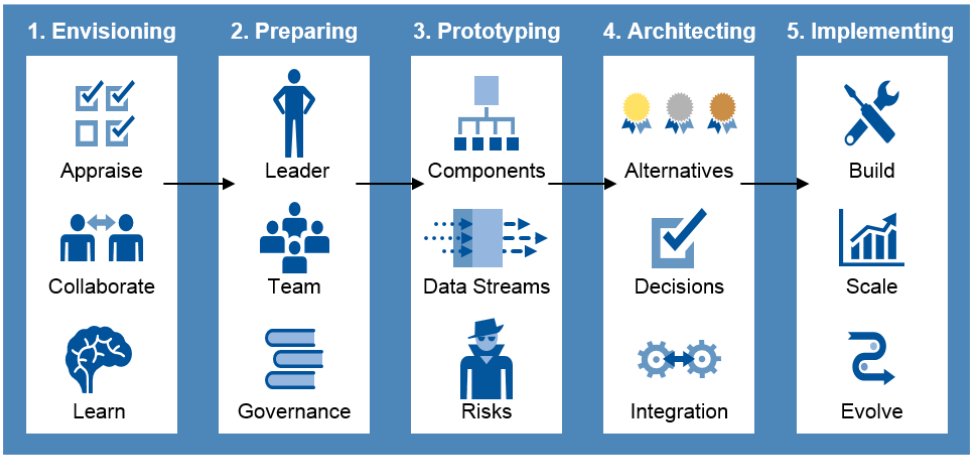
Source: Gartner (October 2016)

Figure 8. Three Parts of an IoT Solution



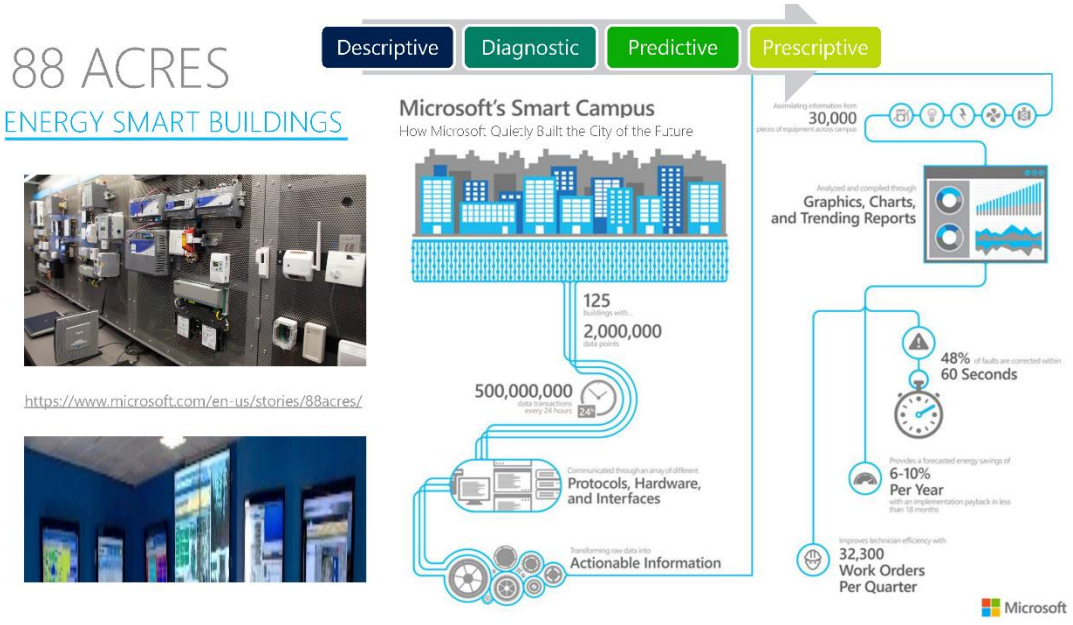
Source: Gartner (October 2016)

Figure 5. Solution Path for Executing an IoT Initiative



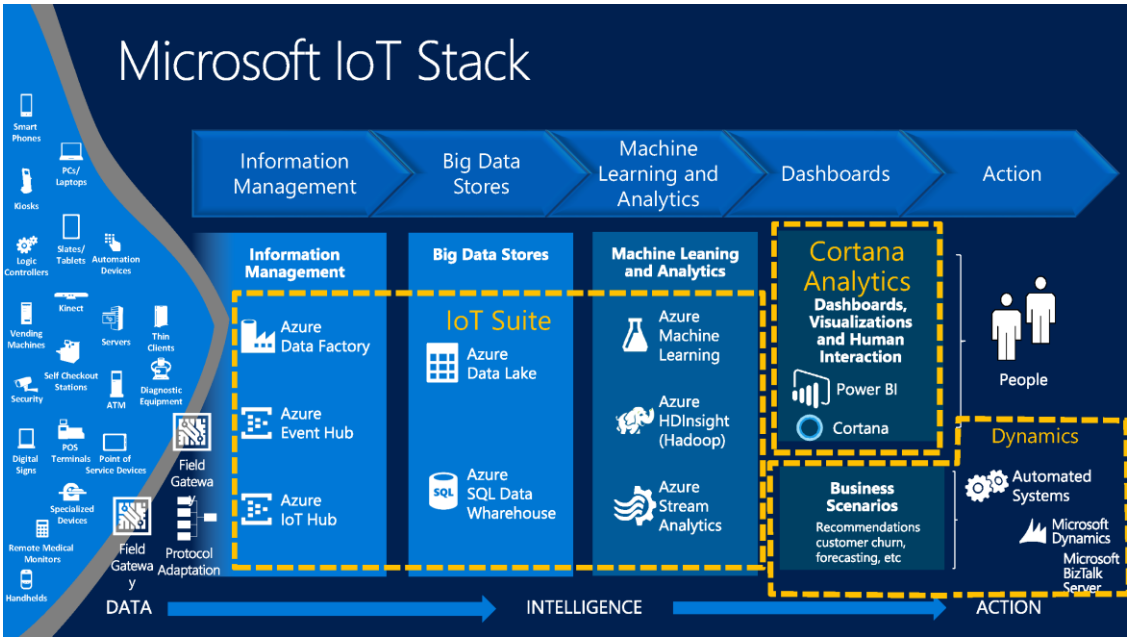
Source: Gartner (October 2016)

- Because platform is the beating heart of IoT, Microsoft's "88 Acres" code name was mentioned:



Revitalize Taiwan Industries with Internet of Things (IoT) by Cathy Yeh, Microsoft-Taiwan

Internet of Things (IoT) Architecture



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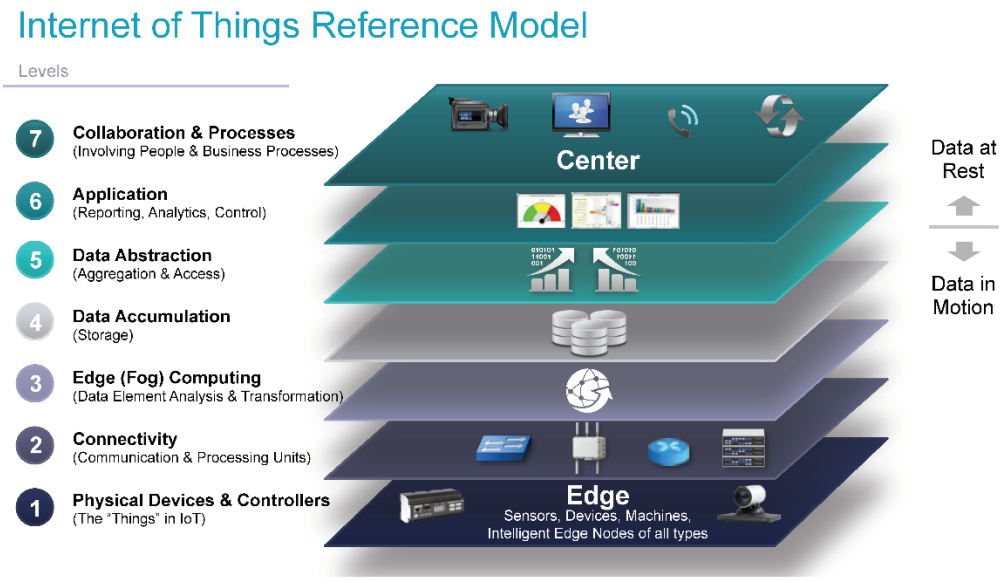
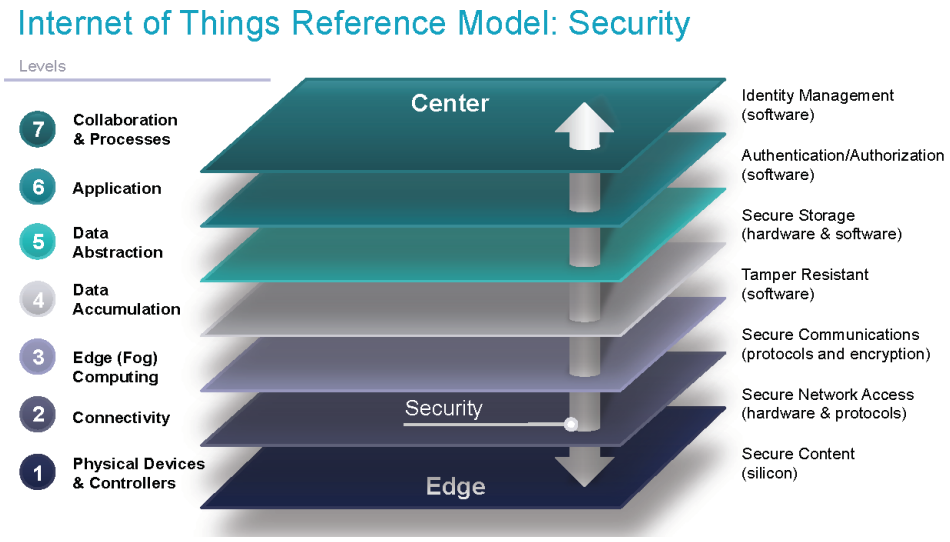


Internet of Things (IoT) Reference Model by Cisco

Internet of Things (IoT) Architecture



Summary

The Internet of Everything (IoT) Reference Model is a decisive first step toward standardizing the concept and terminology surrounding the IoT. From physical devices and controllers at Level 1 to the collaboration and processes at Level 7, the IoT Reference Model sets out the functionalities required and concerns that must be addressed before the industry can realize the value of the IoT. With the goal of enabling the IoT, this reference model provides a baseline for understanding its requirements and its potential.

Internet of Things (IoT) Security Reference Model by Cisco

AWS remains the lead overall maturity, scale, and ecosystem and marketplace.

Azure has good high availability within local regions.

AWS has good high availability across all regions.

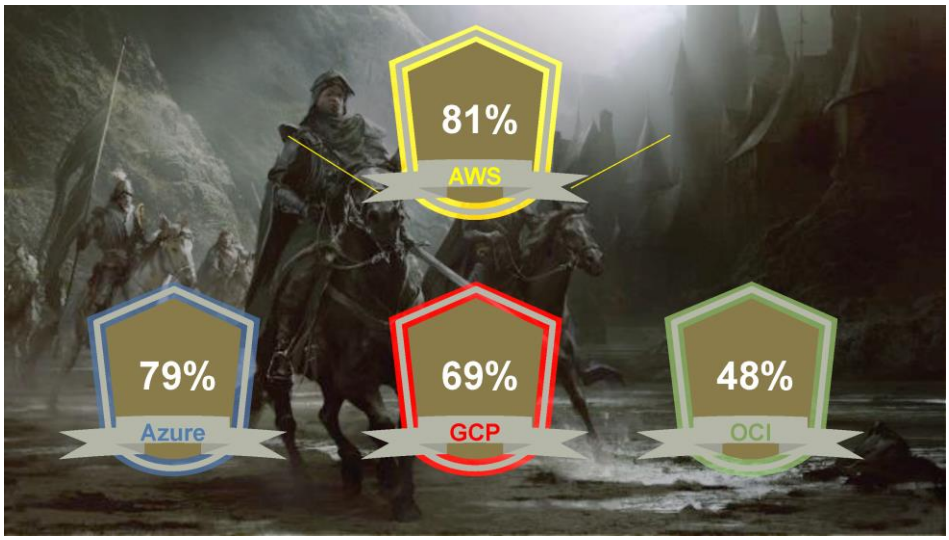
Keep in mind some apps cannot do well in an active/active AWS environment.

Cloud Wars

Comparing Major Cloud Platform Providers

Overview

Research and presentation by Mr. Elias Khnaser of Gartner.

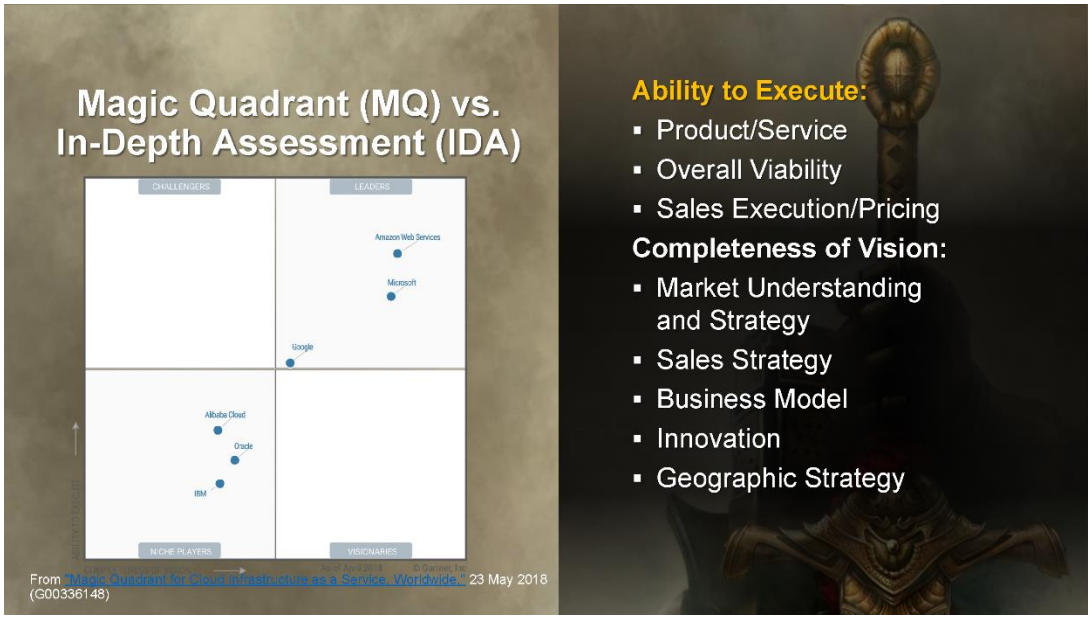


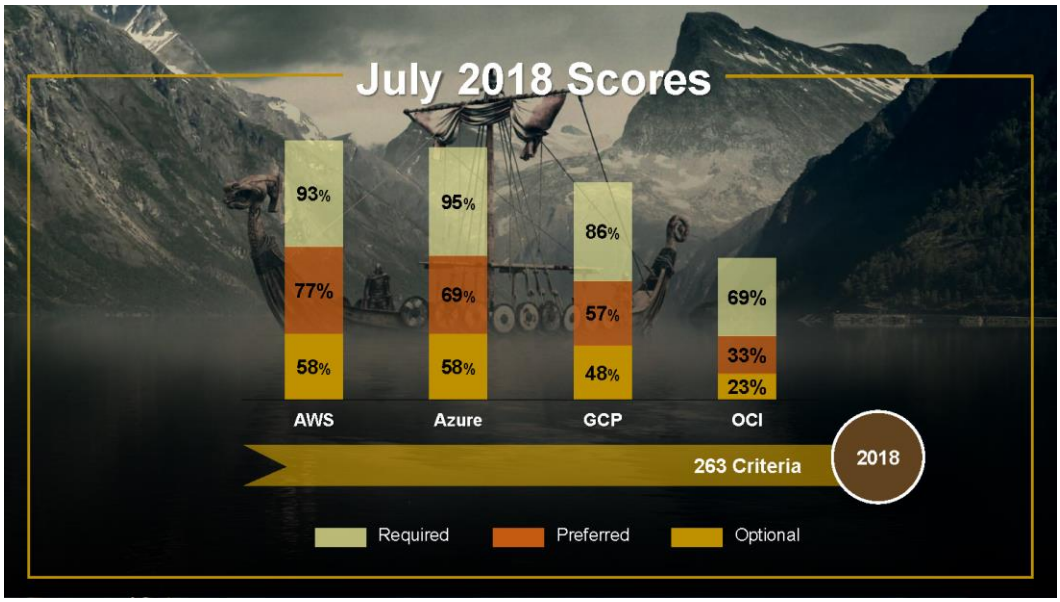
- The comparisons of the various cloud offerings were a result of months of research - @gartnercat
- A multi-cloud strategy is becoming increasingly important.
- AWS and Azure remain dominant in the cloud wars.
- http://clouddecisions.gartner.com
- Some AWS does not have an SLA associated with them such as elastic beanstalk.
- IBM not a lot of change since 2015.
- Oracle cloud moving up infrastructure-wise.
- Alibaba focuses on the Asian market.
- Multi-cloud is inevitable.

Interestingly, AWS has no single instance availability SLA.

Amazon S3 availability SLA is 99.95%.

AWS has no back up service and no VM console access (basic access).





Azure excels in hybrid, identity and access management, and scale.

Azure has:

~ limited availability per zone.

~ no bare metal options.

~ no provider offered Linux distribution

~ no metrics driven load balancing.

~ no regions and zones architectural transparency.

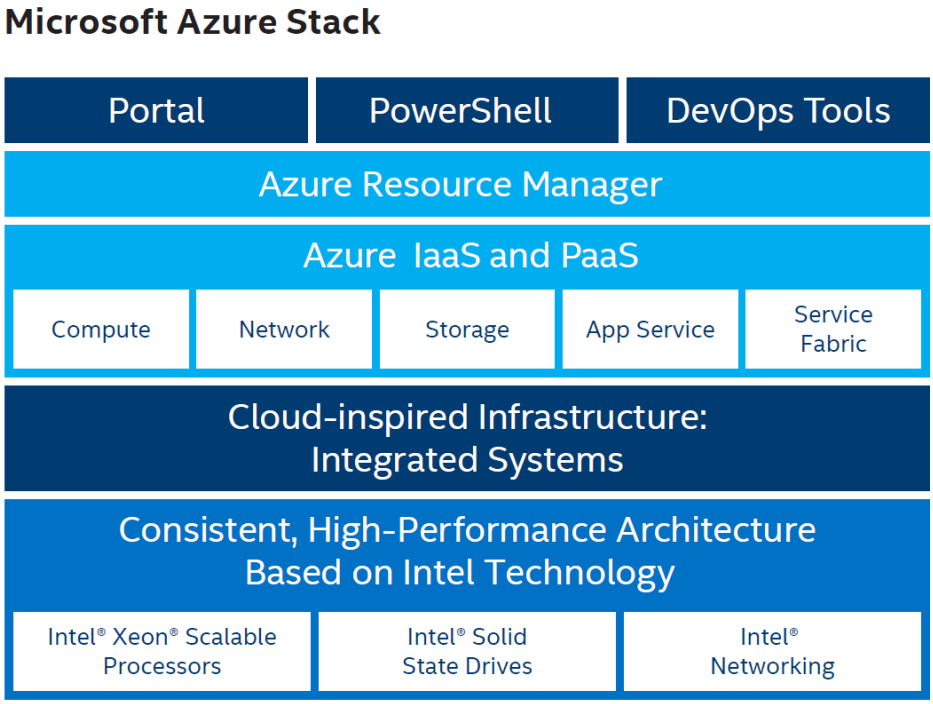


Figure 3. With purpose-built Microsoft Azure Stack integrated systems, powered by Intel technology, organizations quickly gain the power of cloud computing in the on-premises data center.

Google Cloud Platform (GCP) excels in security, technology and network, and financial incentives.

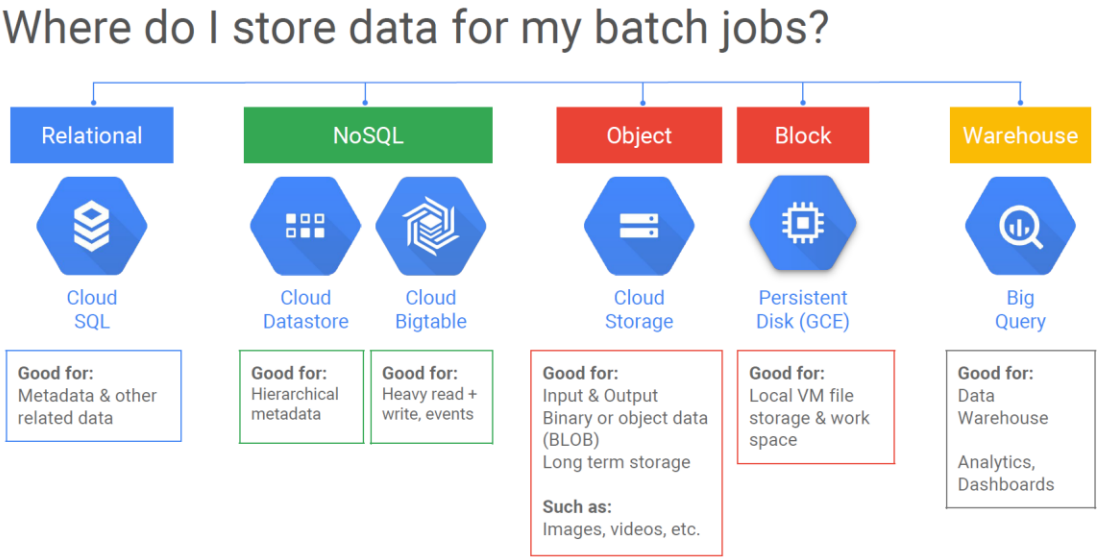
GCP has no:

~ LAN traffic encryption.

~ file storage support.

~ limited logging support for account management provisioning and security.

~ no regions and zones architectural transparency.



Oracle Cloud Infrastructure (OCI) excels in Oracle's Suite of Services, networking, and compute.

OCI has:

~ limited geographic coverage.

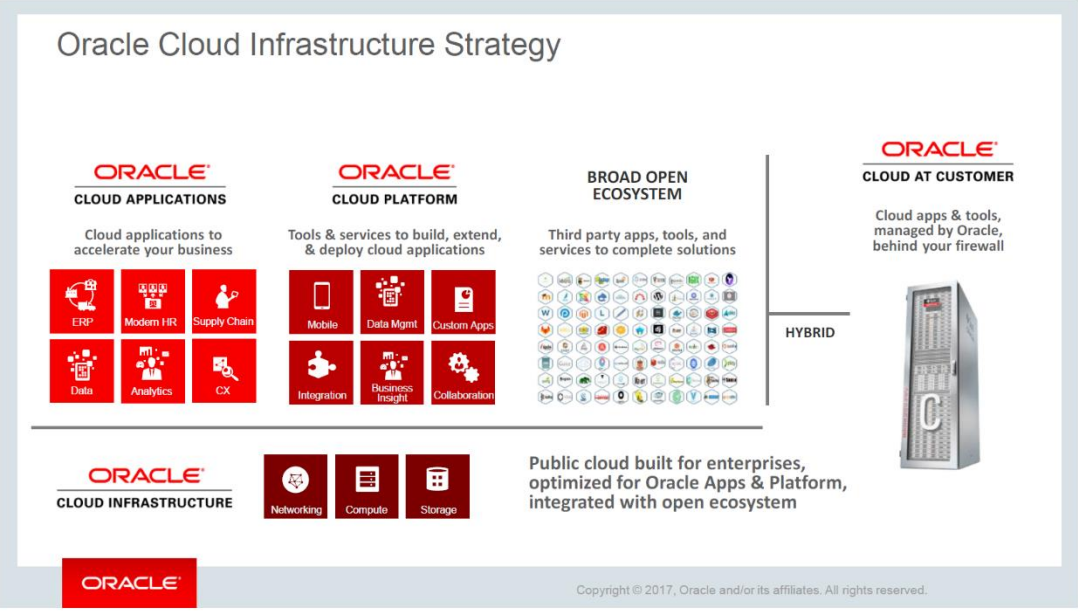
~ no autoscaling service.

~ no cross-geography replication.

~ no backup service.

~ no directory services.

~ no network forensics, etc...



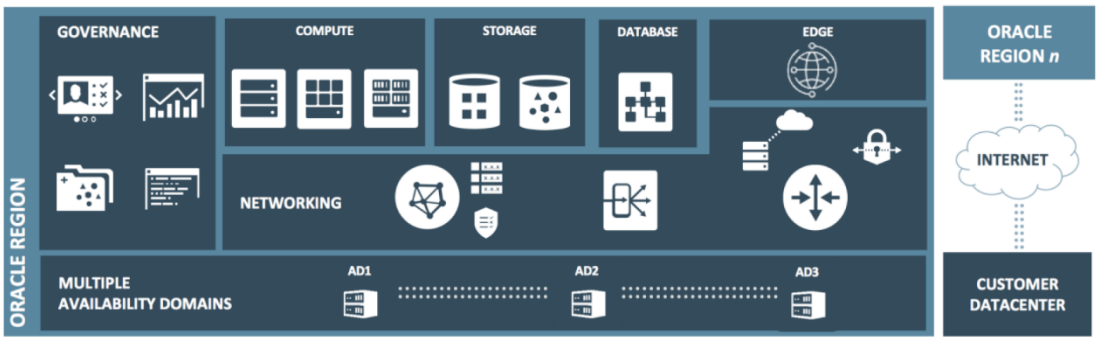


Figure 1. Oracle Cloud Infrastructure High-Level Architecture

Recommendations

- ✓ Create your own unique IaaS evaluation criteria set.
- ✓ Evaluate providers against your criteria.
- ✓ Forecast your future provider requirements:
  - Prioritize feature breadth and innovation?
  - Prioritize history, relationship and integration?
- ✓ Select a provider and begin using, but NEVER sit idle.
- ✓ Move from selection to provider management.
- ✓ Re-evaluate annually and prepare for a multicloud strategy.

Overall Gartner Cloud Provider Recommendations – 2018

Apps are for loyalty.

The web is for reach.

Mobile is for engagement.

State of the Web

The Critical Trends in Architecture, Platforms, and Frameworks

Overview

Research and presentation by Mr. Danny Brian of Gartner.

- Web traffic dominates

Web Traffic by Platform, May 2017

Mobile ❱	51.7%
Desktop ❱	43.59%

Which Browser to Support for Your Own Projects?

Treat anything less than 3% of your user base as unsupported.

Supporting a browser older than 5 years can incur a cost of +50% for development and testing.

Supporting a browser older than three years can incur a cost of +30% for development and testing.

Gartner

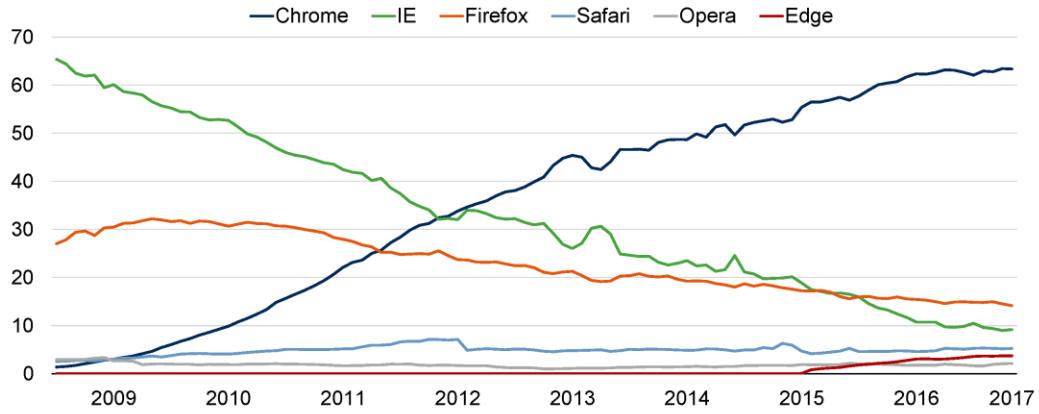
Always have a dual-browser strategy.

No investment in web expertise will be wasted.

Steer clear of more proprietary browsers.

Frameworks are for developer productivity.

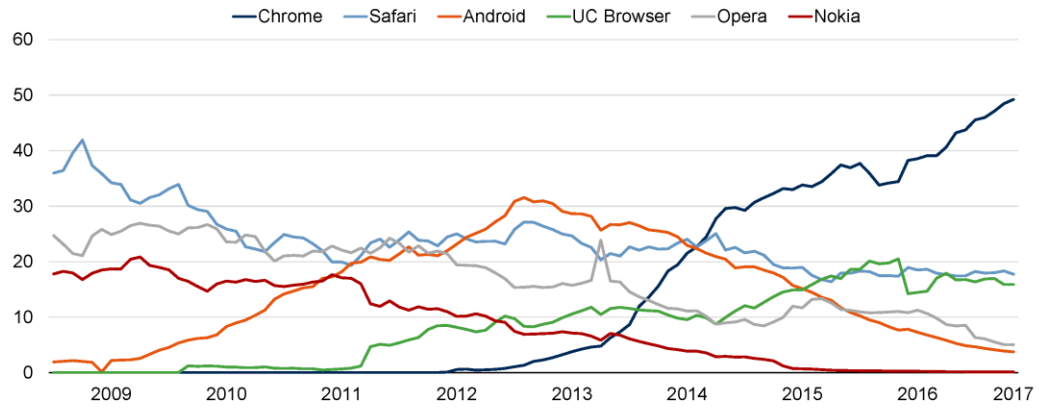
Desktop Browser Share



Source: StatCounter Global Stats

Gartner

Mobile Browser Share



Source: StatCounter Global Stats

Gartner

- Suppliers should support all major browser versions.
- People don't want to always install an app.
- Frameworks will remain to provide structure.
- Use a CSS preprocessor to reduce latency.

Recommendations

- ✓ Educate yourself and your teams on modern HTML5, JavaScript and CSS3 features. Don't skip the basics, and don't learn modern web technologies through the lens of a framework.
- ✓ Aggressively deprecate support for legacy browsers. Make this a matter of business cost-benefit, rather than developer preference.
- ✓ For most use cases, favor modern web app architecture, pushing more application logic to the client.
- ✓ Use web containers such as Cordova to leverage web code for packaged mobile and desktop applications.
- ✓ Test applications on multiple browsers, avoiding any proprietary browser features.

Gartner

By 2023, 20% of organizations will be budgeting for quantum computing projects compared to less than 1% today.

Without hype there is no funding.

62 quantum computing companies currently.

Quantum computing is not ready today.

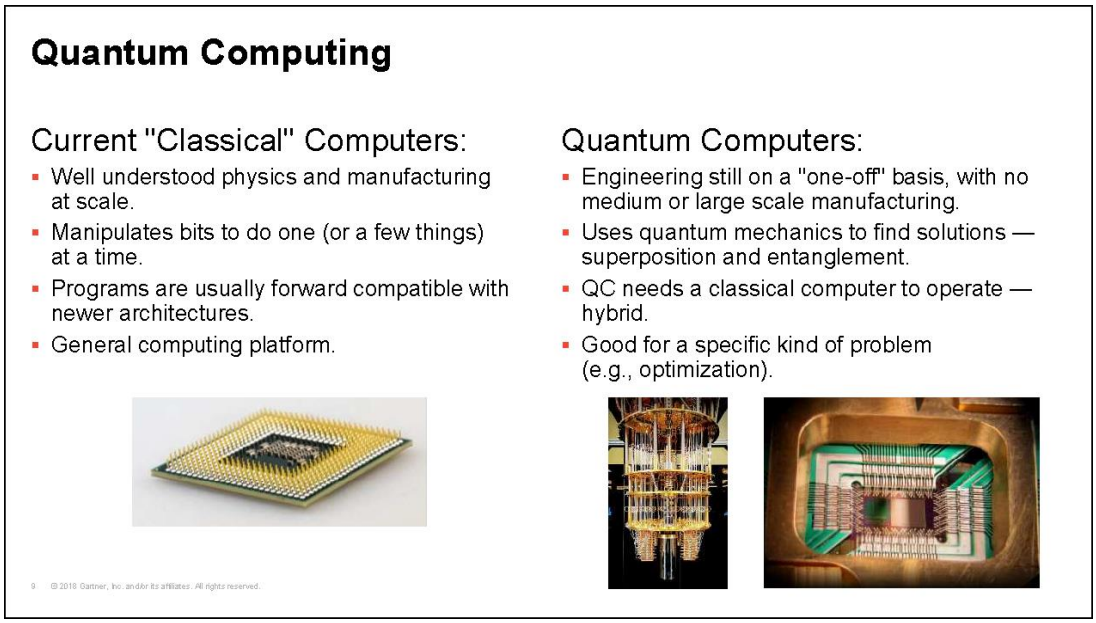
Quantum Computing

The “In Your Face” Disruption Few Understand and Some Fear

Overview

Research and presentation by Mr. Matthew Brisse of Gartner.

- Quantum computing will totally change the computing science landscape in higher education.
- Quantum computing is non-deterministic.
    - For example: 1+1 = 99.99% probability the solution is 2.
- Commercially viable for specific problems in six to ten years.
- Machine learning is the biggest quantum use case.
- Financials services planning on usage in 2027.



- 4IR = Fourth Industrial Revolution – Quantum, Artificial Intelligence (AI), Machine Learning, etc.

Quantum Computing

You won't be using a Quantum computer to run your Microsoft Word app.

Quantum Computing as a Service — QCaaS

Gartner positions this as the deployment model of choice for most organizations due to cost and operations.

- IBM Q: "The Future Is Quantum":
  - 88,000 users: Researchers and programmers have signed up
  - ~4.6 million experiments run
  - >85 research papers from seven continents
- D-Wave Systems: (Annealer — no entanglement)
  - Lease/Time share service
  - Sold commercially
- Code available on GitHub

Gartner

- Gartner has received over 300 calls from CIO's / CTO's on Quantum through July 2018.
- Quantum algorithms are coming first for use in machine learning.

Early Pioneers in Quantum Computing

NEC, Fujitsu, rigetti, JPMorgan Chase & Co., 1QBit, QCWare, Microsoft, Google, intel, IBM, Honda, Volkswagen, NASA, Mitsubishi, Nokia, D-Wave The Quantum Computing Company, Raytheon, Harvard, Daimler, Lockheed Martin, IonQ, Alibaba Group 阿里巴巴集团, NTT, Hewlett Packard Enterprise, Barclays, Nagase, Toshiba, Harris, Materials Magic, TU Delft

(Many more not listed)

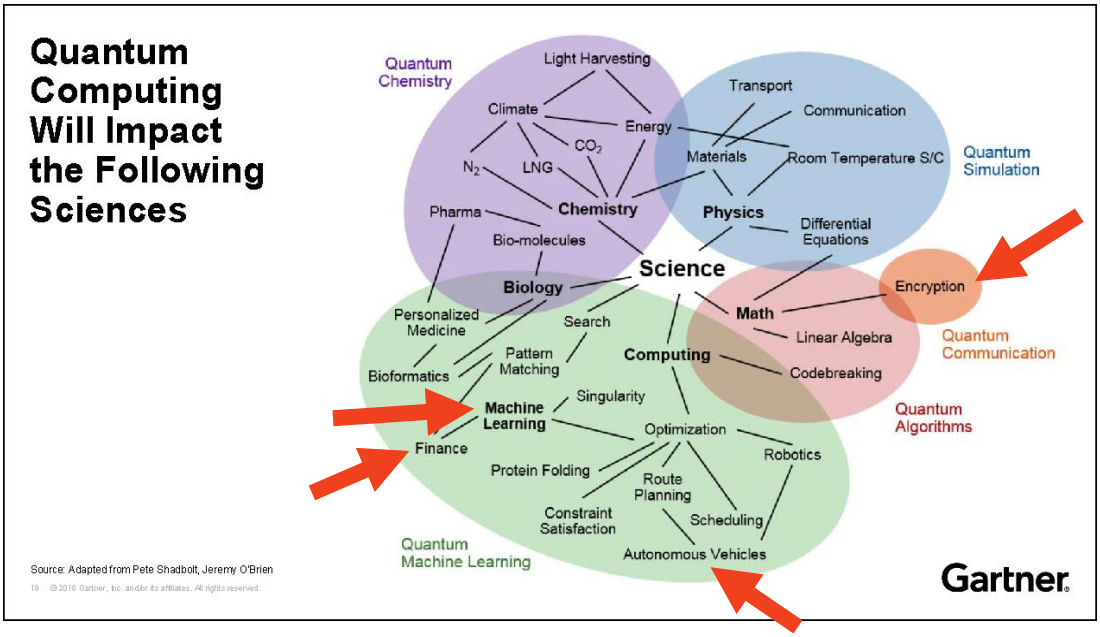
Gartner

- All quantum chips are one off's.

Quantum Computing

Quantum computers must currently be tuned twice a day.

- Exponential speed up – N^{300} instead of N^2 (1's and 0's).
- Computational scientist will take problems to quantum system for highest probability solutions.



Quantum Impact on Security — What Is Vulnerable?

Cryptographic Algorithm	Type	Purpose	Impact When Large-Scale Quantum Computers Are Achieved
AES-256	Symmetric key	Encryption	Probably okay
3DES	Symmetric key	Encryption	Must be deprecated
SHA-2, SHA-3		Hashing	Quantum safe algorithms
FIPS PUB 186-4	Digital signature standard	Signatures (public key + hashing)	No longer secure
SP 800-56A/B	Pairwise key establishment schemes	Key establishment	No longer secure
RSA	Public key	Signatures, key establishment	No longer secure
ECDSA, ECDH (Elliptic Curve Cryptography)	Public key	Signatures, key establishment	No longer secure
DSA (Finite Field Cryptography)	Public key	Signatures, key establishment	No longer secure

Source: NIST Guidance

Gartner

Banks have to be concerned about quantum.

Prepare for Post Quantum — What Is Vulnerable?

Technology	Application	Impact
Public Key Infrastructure (PKI)	Certificates Key management	PKI will need to be moved to quantum-safe cryptography Existing PKI will be deprecated Credentials will need to be reissued
Digital Signatures	Contracts (mortgages, agreements) that extend beyond 2022 Secure email Timestamps Hashed-linked logs and records	PKI-dependent Hash values will need to be lengthened
Cryptographic Hash Functions	Integrity checks Logs Password security	Hash values will need to be lengthened
Blockchain/ Public Ledgers	Contracts Cryptocurrency Proof of work	PKI-dependent Credentials will need to be reissued Hashes lengthened Blockchains may need to be resigned
Data Security	Stored/Encrypted data SSL/TLS	Personal records where data needs to be secret for decades 70 years or more PKI-dependent Key storage and exchange will need new protocols

Move to quantum safe algorithms as providers make them available …

Source: NIST Guidance

Gartner

Quantum Resistant: Future-Proof Now

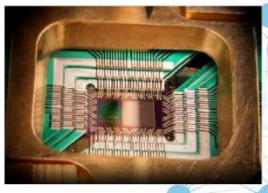
SecureRF's methods are quantum-resistant to all known attacks

"The National Security Agency is advising US agencies and businesses to prepare for a time in the not-too-distant future when the cryptography protecting virtually all e-mail, medical and financial records, and online transactions is rendered obsolete by quantum computing."

Source: Ars Technica, August 21, 2015

"…We must begin now to prepare our information security systems to be able to resist quantum computing."

Source: NIST Report on Post-Quantum Cryptography February 2016



D-Wave System Chip with quantum Properties

SECURE RF

Security Essentials for IoT Product Developers – SecureRF 2017

Quantum Resistance

- Two important quantum methods: Shor's Algorithm and Grover's Search Algorithm
- Grover's Search Algorithm reduces security level (e.g., AES-128 becomes 64-bit secure)
  - Doubling the security of GTC requires doubling the key size which only doubles the runtime
- Shor: Breaks ECC, RSA, and DH by quickly factoring/solving the discrete log problem
  - Requires the method's math be Finite, Cyclic, and Commutative
  - GTC is neither Cyclic nor Commutative, and the underlying group is Infinite - Shor does not apply

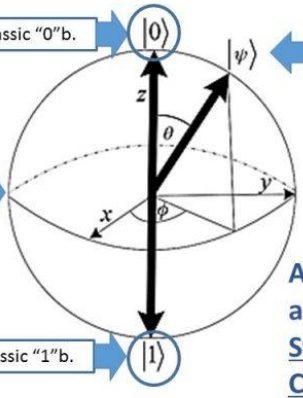
SECURE RF

Security Essentials for IoT Product Developers – SecureRF 2017

- Quantum computing positions the qubits and then reads them.
- Qubit = electrons.
- Need 150-300 qubits to do meaningful work.
- Need an oscilloscope to read qubits.

What If We Don't Limit Ourselves to 1's and 0's? The Quantum Computer Qubit

Here's your classic "0"b.



Note: Even though you cannot look inside the qubit and see it during quantum computation, all the points on the Bloch sphere are part of the quantum computation. When the computation is over, you'll read the qubit and see "0"b or "1"b but that doesn't happen until the end of the quantum operation.

Here's your classic "1"b.

A Quantum Qubit

$$|\psi\rangle = \begin{bmatrix} c_0 \\ c_1 \end{bmatrix}$$

$$|\psi\rangle = c_0|0\rangle + c_1|1\rangle$$

$$|\psi\rangle = cos(\theta)\,|0\rangle + ei^{\phi}\,sin(\Theta)\,|1\rangle$$

A Bloch Sphere Represents a Quantum Qubit – And It Still Uses the Traditional Cbit

Security Innovation
THE APPLICATION SECURITY COMPANY

NTRU

- To be considered quantum a machine must do entanglement.
    - D-Wave is technically not quantum because it can't do entanglement.

A QUANTUM COMPUTING PRIMER

Quantum computers are different from the digital computing that drives today's data centers, cloud environments, PCs and other devices. Digital computation requires data to be encoded into binary digits (bits), each of which is always in one of two definite states (0 or 1). However, quantum computation uses quantum bits (qubits), which can be in multiple states simultaneously. As a result, operations on qubits can amount to a large number of calculations in parallel. It has been shown that in theory, some specific problems should be solvable in much less time on a quantum computer than using the best known algorithms for a conventional computer. Here are four key concepts that are the foundation of quantum computing.

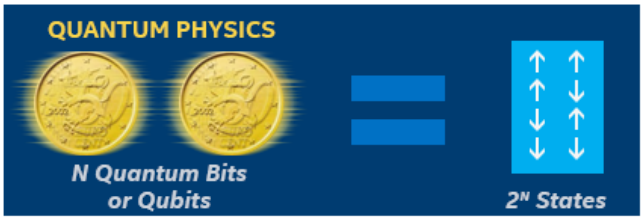
1 SUPERPOSITION

Think of classical physics as a coin. It can be either heads or tails. If it were a bit, it would be 0 or 1. In quantum physics, this coin is best thought of as a constantly spinning coin. It represents heads and tails simultaneously. As a result, a **qubit** would be both 0 and 1 and spin simultaneously up and down.

Quantum state: a simultaneous representation of multiple classical states.

2 ENTANGLEMENT

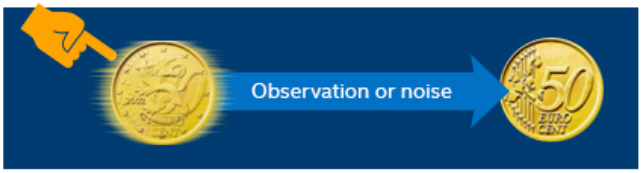
Entanglement gives quantum computing the ability to scale exponentially. If one qubit simultaneously represents two states, two qubits represents four states when coupled together. They can no longer be treated independently; they now form a **coupled,** or **entangled, super state**. As more qubits link together, the number of states exponentially increase, which could lead to a computer with astronomically large computing power.



The **two qubits** can no longer be treated independently. They form a **super state**.

3 FRAGILITY

Quantum states are quite **fragile**. If you measure, observe, touch, or perturb any of these states, they collapse to a classical state. The states don't stick around for very long, which is why quantum computers are currently hard to build.



A **quantum state** collapses to a classical state if disturbed by noise or measurement.

4 NO CLONING

A corollary to fragility is the '**No Cloning Theorem**.' In classical physics, if two bits are represented by the coins below, one can copy or eavesdrop and recreate the information. In contrast, the information entangled within a set of qubits will be lost if someone tries to observe or copy them. A quantum state cannot be copied without the sender or receiver realizing this. This concept serves as the basis of quantum communications.

One **cannot** copy, intercept or steal without ruining a quantum state.

Quantum computing holds a credible promise of radically enhanced performance, with the potential to solve specific complex problems that are practically unsolvable by today's computers. Development of actual quantum computers is still in its infancy, but quantum computing has the potential to solve complex simulations such as large-scale financial analysis and more effective drug development.

- Free quantum computing is available on the web today.

Quantum Computing

Don't ignore quantum computing!

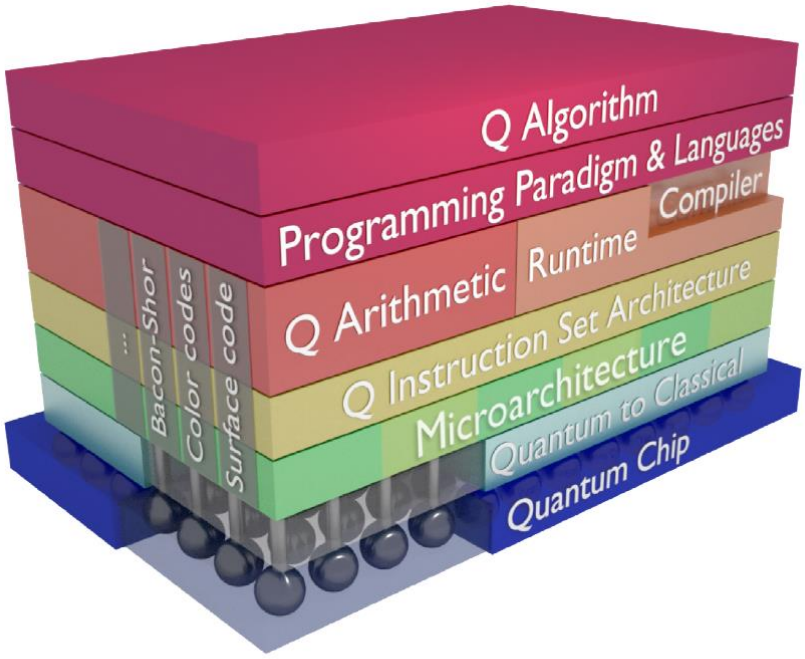


Figure 2.7: Quantum computer system stack [16]

Recommendations

- ✓ Learn all you can about quantum computing now while you have time.
- ✓ Increasing awareness of across research and application teams.
- ✓ Minimize risk by utilizing quantum as a service (QCaaS) techniques to start becoming familiar with quantum algorithms — still experimental.
- ✓ Begin by selecting quantum programming approaches that are supported across cloud and QC platforms.
- ✓ Focus on quantum algorithms that could potentially solve real world problems.

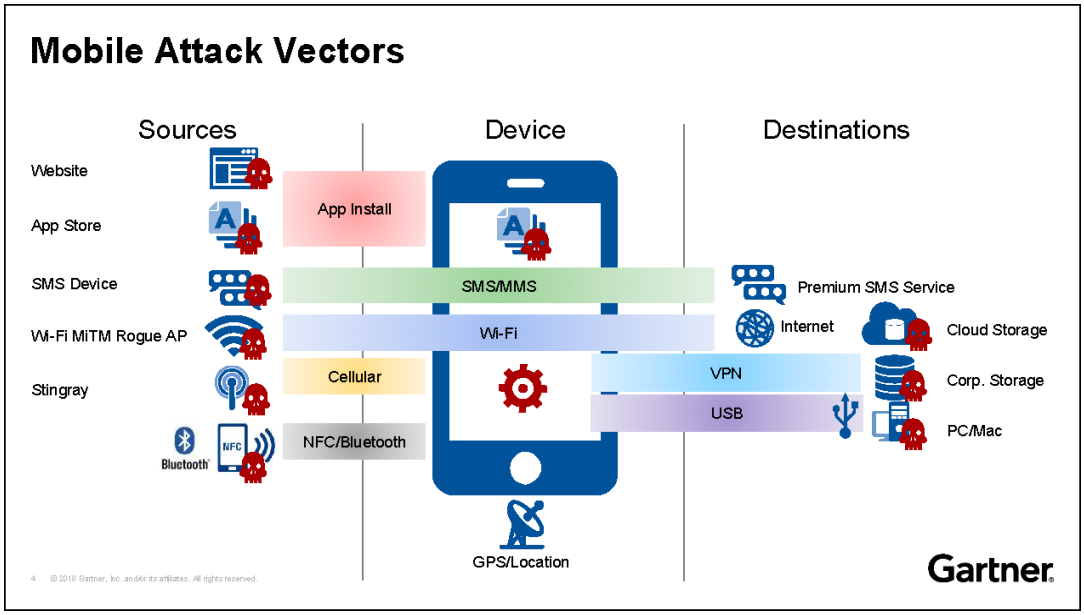
Gartner

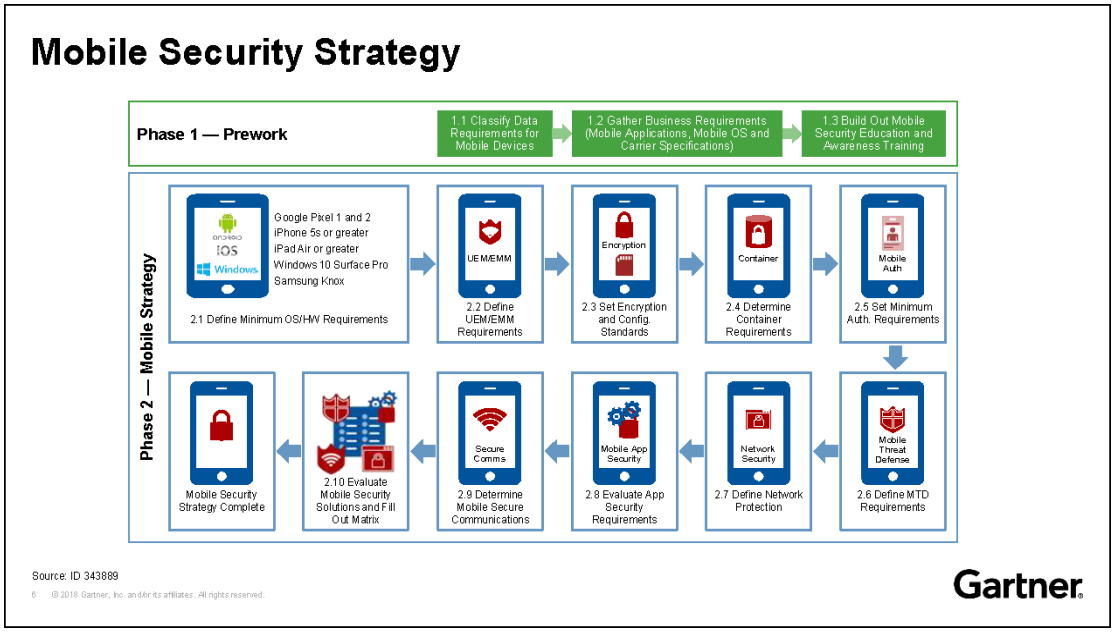
Mobile Security Strategy

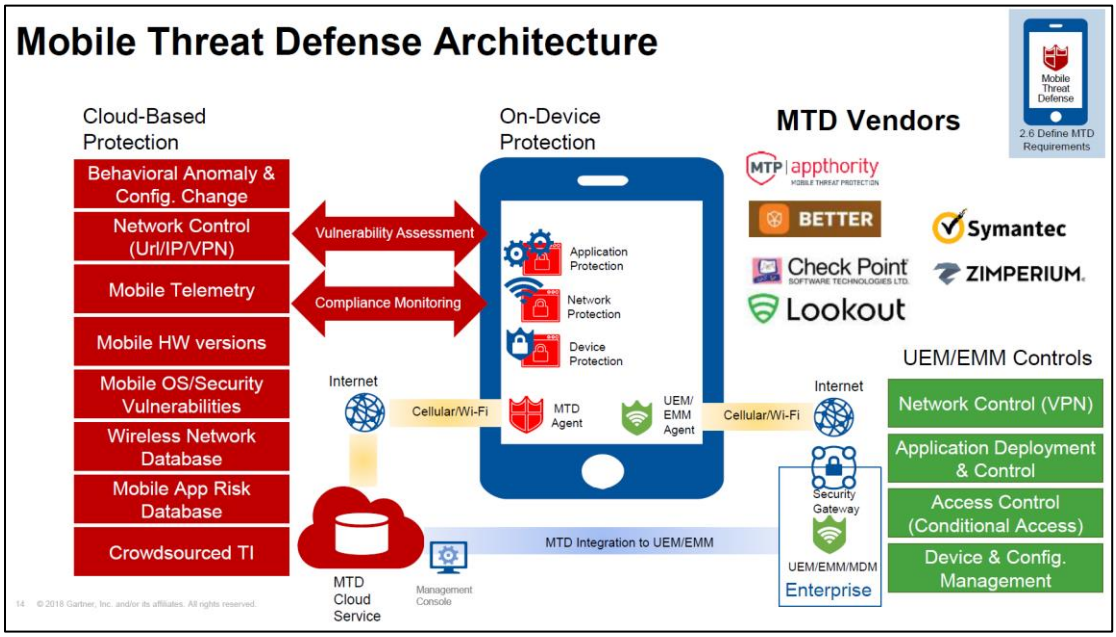
How to Evolve Your Mobile Security Strategy in 2018

Overview

Research and presentation by Mr. Eric Maiwald of Gartner.




Mobile Security Strategy
Phase 1 — Prework
1.1 Classify Data Requirements for Mobile Devices
1.2 Gather Business Requirements (Mobile Applications, Mobile OS and Carrier Specifications)
1.3 Build Out Mobile Security Education and Awareness Training
Phase 2 — Mobile Strategy
Google Pixel 1 and 2
iPhone 5s or greater
iPad Air or greater
Windows 10 Surface Pro
Samsung Knox
2.1 Define Minimum OS/HW Requirements
UEM/EMM
2.2 Define UEM/EMM Requirements
Encryption
2.3 Set Encryption and Config. Standards
Container
2.4 Determine Container Requirements
Mobile Auth
2.5 Set Minimum Auth. Requirements
Mobile Threat Defense
2.6 Define MTD Requirements
Network Security
2.7 Define Network Protection
Mobile App Security
2.8 Evaluate App Security Requirements
Secure Comms
2.9 Determine Mobile Secure Communications
2.10 Evaluate Mobile Security Solutions and Fill Out Matrix
Mobile Security Strategy Complete
Source: ID 343889
Gartner


Mobile Threat Defense Architecture
Mobile Threat Defense
2.6 Define MTD Requirements
Cloud-Based Protection
Behavioral Anomaly & Config. Change
Network Control (Url/IP/VPN)
Mobile Telemetry
Mobile HW versions
Mobile OS/Security Vulnerabilities
Wireless Network Database
Mobile App Risk Database
Crowdsourced TI
Vulnerability Assessment
Compliance Monitoring
On-Device Protection
Application Protection
Network Protection
Device Protection
MTD Agent
UEM/ EMM Agent
Internet
Cellular/Wi-Fi
Internet
Cellular/Wi-Fi
MTD Cloud Service
Management Console
MTD Integration to UEM/EMM
Security Gateway
UEM/EMM/MDM
Enterprise
MTD Vendors
MTP appthority
BETTER
Symantec
Check Point
ZIMPERIUM.
Lookout
UEM/EMM Controls
Network Control (VPN)
Application Deployment & Control
Access Control (Conditional Access)
Device & Config. Management

Corporate Managed Security Strategy Recommendations

- ✓ Evaluate the risks and new tactics being leveraged on mobile devices by malware by keeping current with mobile threat reports.
- ✓ Set minimum mobile OS and device standards.
- ✓ Enforce applications are installed only from trusted sources (Google Play, Apple Store, Windows Store or Enterprise Apps Store).
- ✓ Evaluate mobile threat defense (MTD) solutions with cloud-based application reputation services with EMM enforcement.
- ✓ Deliver training to drive user awareness of which permissions mobile applications are requesting. This approach can help reduce unwanted applications from being installed.

Gartner

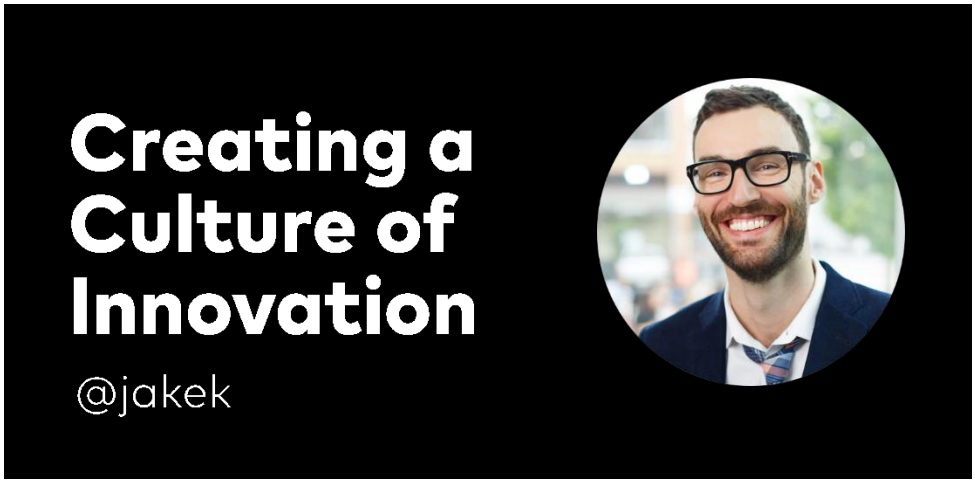
BYOD Security Strategy Recommendations

- ✓ Evaluate the risks and new tactics being leveraged on mobile devices by malware by keeping current with mobile threat reports.
- ✓ Set minimum mobile OS and device standards.
- ✓ Verify applications are installed only from trusted sources (Google Play, Apple Store, Windows Store or Enterprise Apps Store).
- ✓ Evaluate mobile threat defense solutions with cloud-based application reputation services.
- ✓ Enforce adaptive access based on the state of the device.
- ✓ Deliver training to drive user awareness of which permissions mobile applications are requesting. This approach can help reduce unwanted applications from being installed.

Gartner

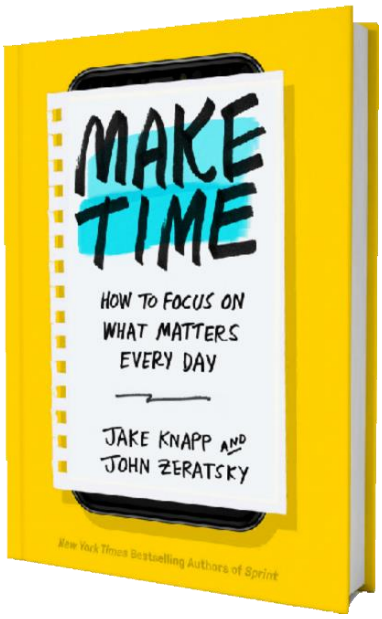
Find the best ideas and implement them!

Innovation Culture



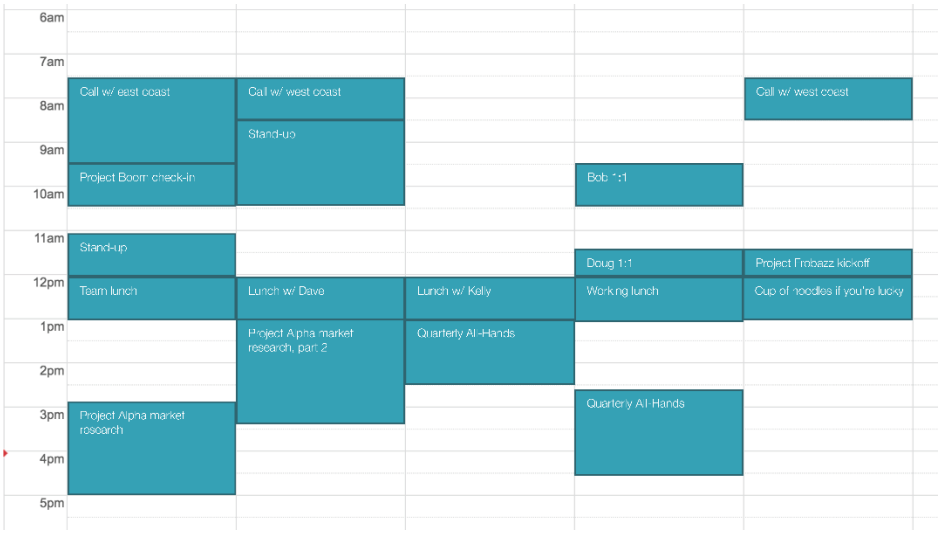
Overview

Research and presentation by Mr. Jake Knapp – New York Times Best Selling Author.

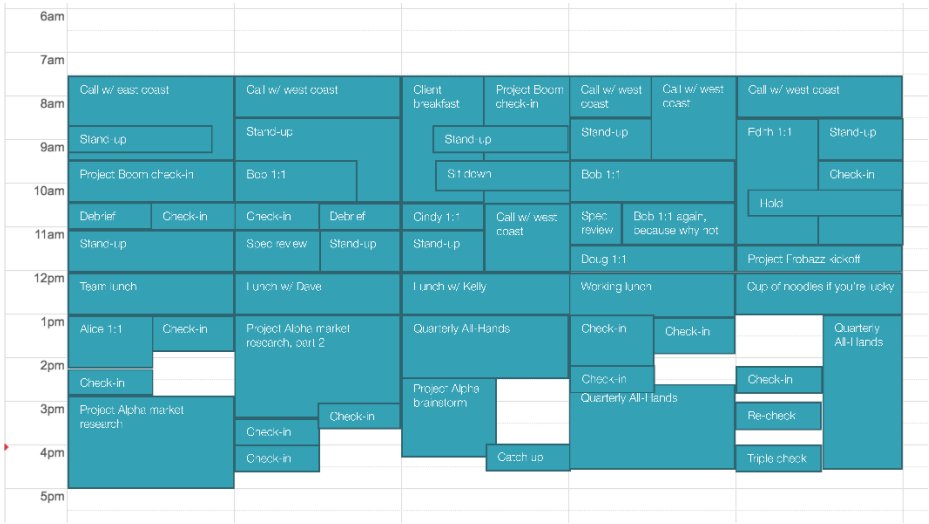


- Best individual keynote of the conference.
    - Very engaging presentation.

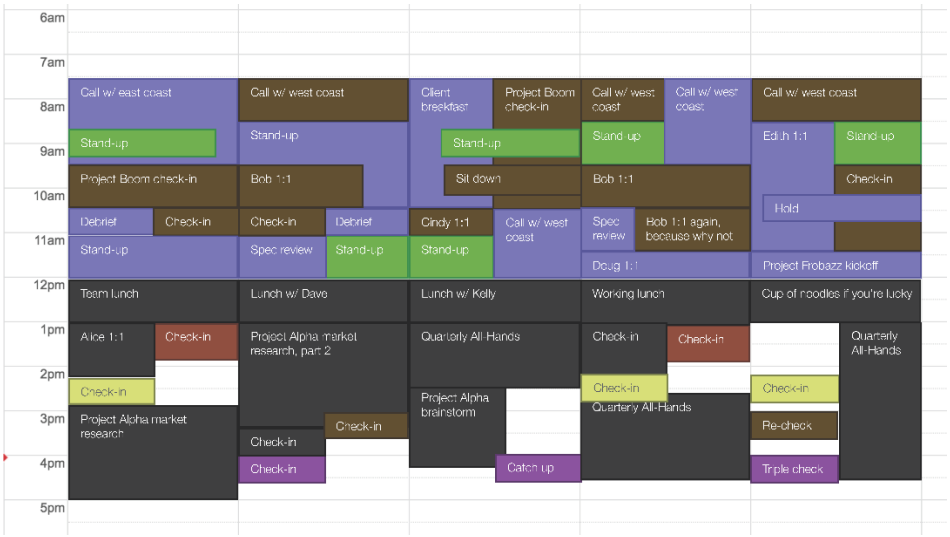
- Mentioned the problem we all have with current methods where he would start putting appointments on his calendar and it was looking good and doable:



- But then he was slammed all week and it was getting complicated and crammed and becoming unmanageable:



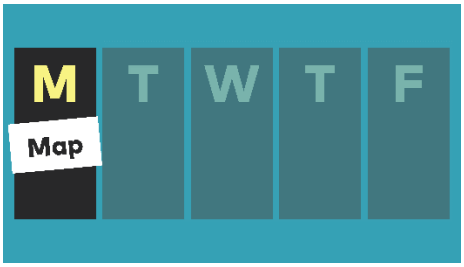
- His calendar then got so stuffed he had to color code it to better track stuff:



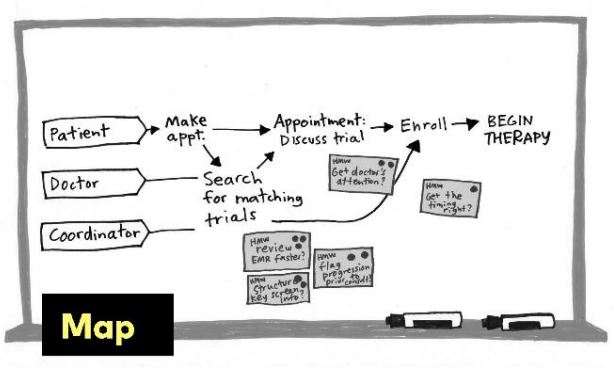
- Finally with multiple back-to-back appointments and overbookings, the calendar started to make him feel like the frog in the Frogger Game where it was all he could do to just start each day (bottom of game) and try to reach the end of the day (top of the game) alive:

- There has GOT to be a better way. So he decided on a new approach.

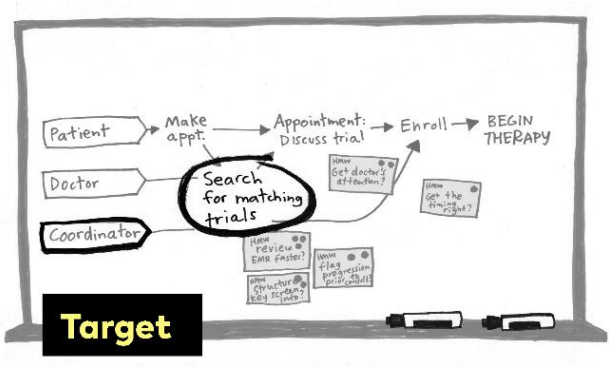
- On Monday, make a map for the week and design your time.
    - Generally the default for the week is to do everything at once in a multi-tasking world, but how about instead focus on one key moment and completing it?



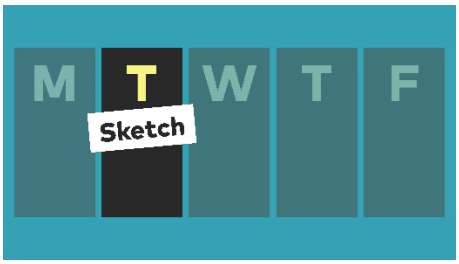
    - Decide what needs to be accomplished:



    - Then target specifically what you want to finish this week – what is doable:

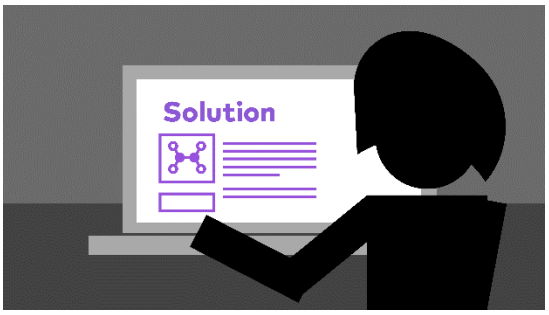


- On Tuesday, sketch out a solution:



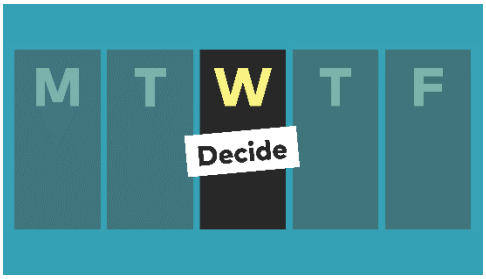
- Base solution on the groups ideas:
    - Default is to brainstorm, but that wasn't working for a variety of reasons.

    - How about with a sprint, have each person come up with an idea on their own at the group desk, or their own desk, or wherever is comfortable for them. Each person identifies a solution for that idea in good detail using whatever necessary research method they are comfortable with and at their pace:



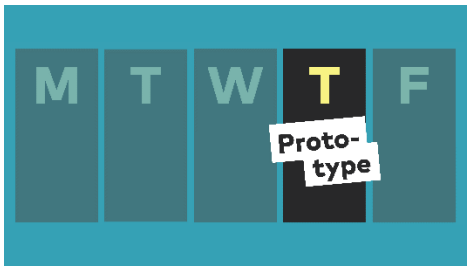
- Then that same day everyone meets back as a group, and everyone presents their idea and their solution so all are equally valued by being given time to voice and explain their solution. Now instead of just brainstorming ideas where extroverts take over, there are a bunch of ideas with solutions from each member of the group, and everyone can think about each solution.

- On Wednesday, the group decides which solution(s) is the best:

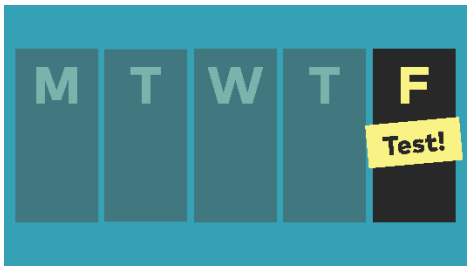


- Default with deciding on an appropriate solution is generally endless discussion, but in a sprint environment, it's fast and decisive through a structured decision process that allows the decider to decide:

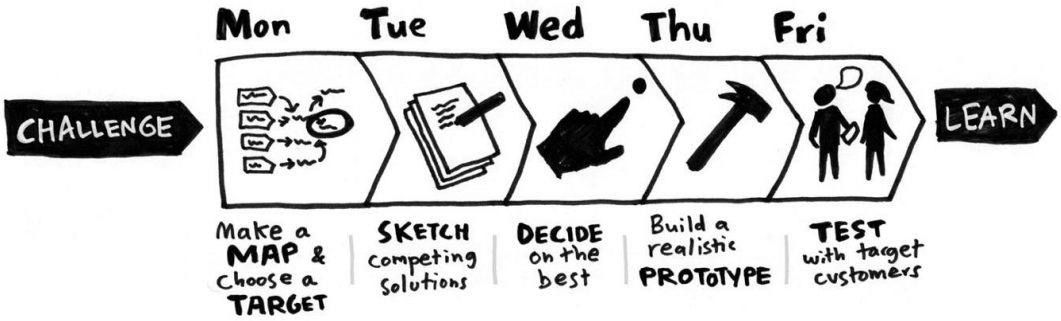
- On Thursday a prototype is developed:



- On Friday test your developed prototype:



  - Quit wasting time on:
    - Ideas that suck
    - Arguments
    - Politics
    - Meetings
    - Playing it safe
  - Default behavior is to play it safe, but with sprint it is to take big risks.
  - Default behavior is one bet, but with sprint it is parallel universes.



- For years, people have told us group brainstorms don't work. Here are well-written articles on the topic from 2010, 2011, 2012, 2013, 2014, and 2015. And this isn't some recent trend—half of those articles cite a 1958 Yale study which found that individuals working on their own are emphatically better at problem-solving than teams of brainstormers. And yet, we keep right on brainstorming. We have a problem to solve, we have a group of people, and somebody says, "Let's brainstorm a few ideas." We can't resist.
- The best ideas – the solutions that teams actually executed – came from individual work.

http://jakenapp.com/sandiego

Lock-in is a concern in the cloud, but you can't eliminate it entirely.

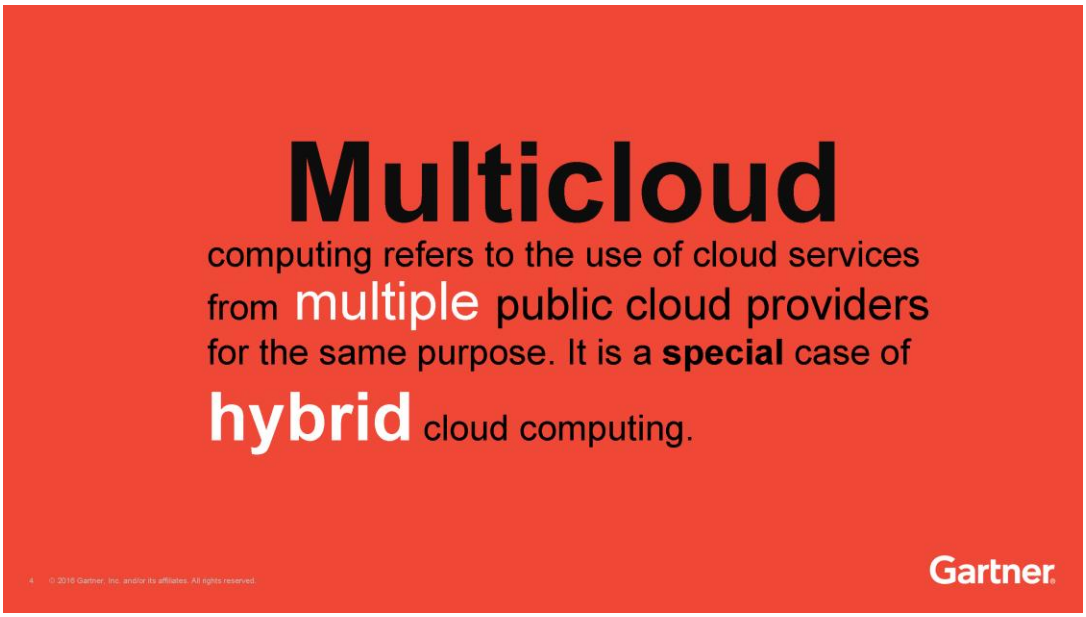
For instance, unexpected lock-in with a cloud provider may occur through the sheer mass of data you have at one provider.

Multi-Cloud Playbook

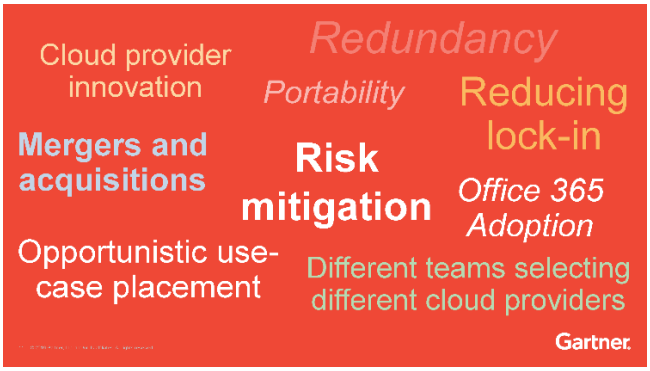
Your Multi-Cloud Playbook: Strategy, Architecture, Use Cases, and Deciding Which Application to Migrate to Which Cloud

Overview

Research and presentation by Mr. Elias Khnaser of Gartner.



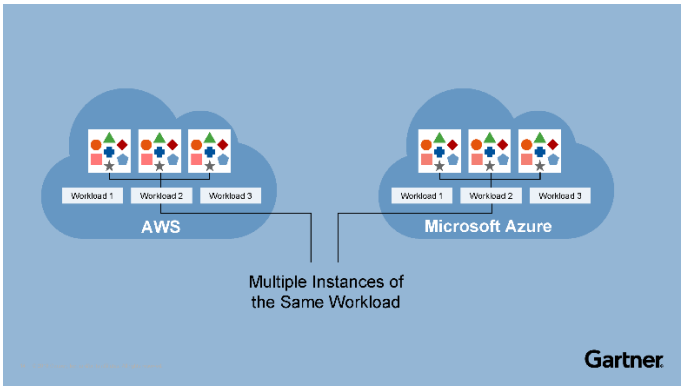
- Multi-cloud is a special hybrid cloud case.
- Difficult to figure out if an application should be in Azure, AWS, etc., because the main cloud suppliers are at feature parity.
- Production scenarios are good with redundant multi-cloud.
- Most multi-cloud today is redundant multi-cloud.
- Azure is good for system of record.
- Gartner says that every single inquiry call they receive ends in a mult-cloud conversation.
- What is driving multi-cloud?



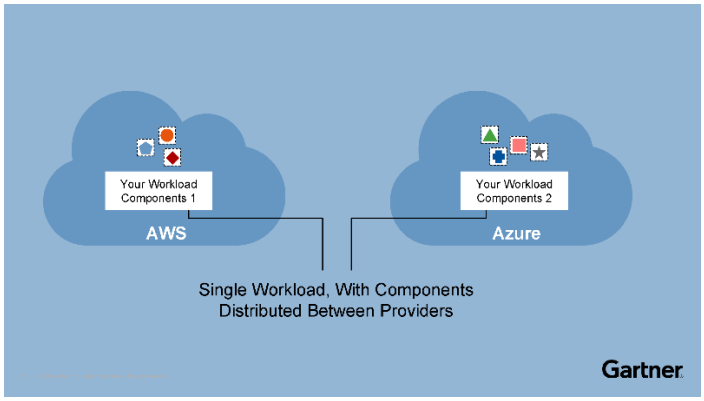
- The biggest pull to Microsoft's Azure cloud is Office-365.

- AWS is great for DR.

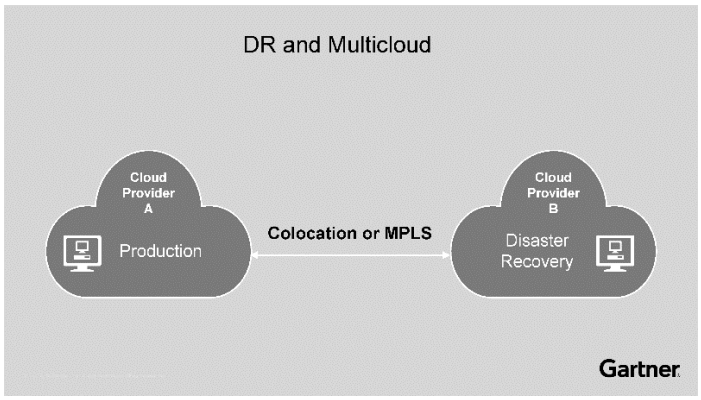
- High performance computing (HPC) is popular with multi-cloud.
- Cloud providers must allow connections to other data centers.
- VDI can be a challenge in a multi-cloud environment.
- 3rd party PaaS is interesting, difficult, and attractive, but not always possible.
- Continuous multi-cloud that is far away from native communications is very expensive – financial institutions are trying it.
- Workload placement can be generally with either Azure or AWS.
    - Azure is rolling out more availability zones, but currently AWS is better.
- High performance computing (HPC) on spot instances is best with AWS.
- For SMB on CIFS shares go with Azure.
- AWS is more automated with objects.
- SLA's with Azure are better.
- Multi-cloud architectures are:
    - Redundant Multi-cloud:

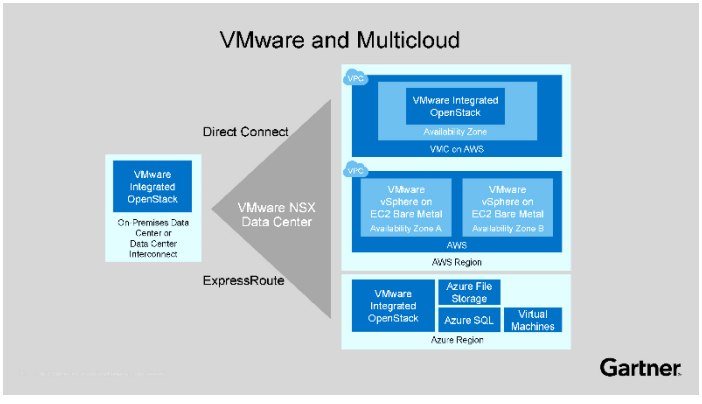


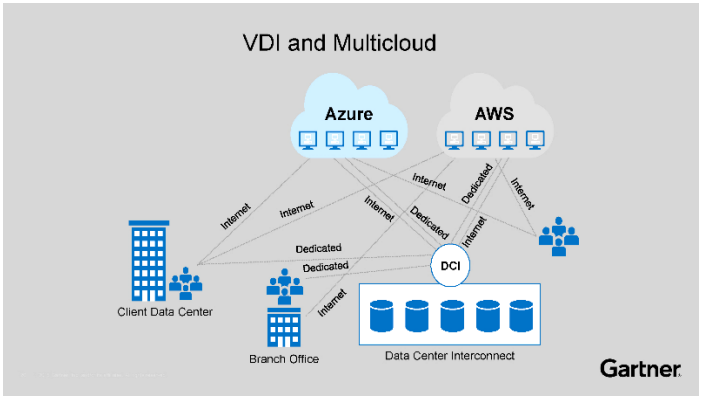
    - Composite Multi-cloud:

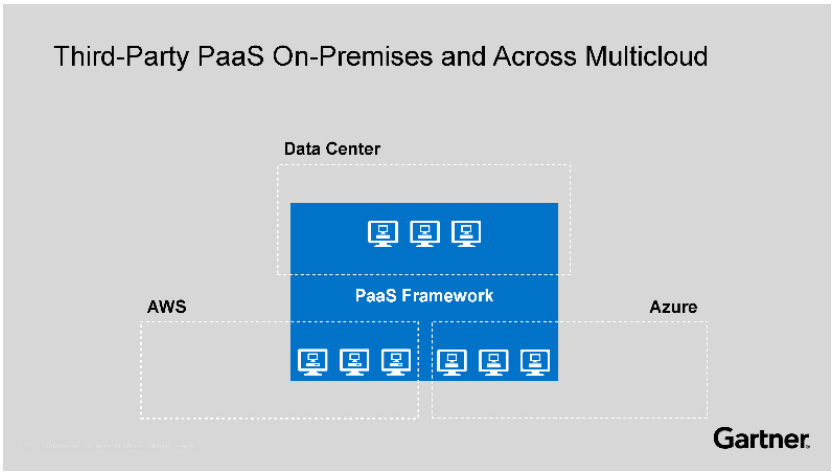


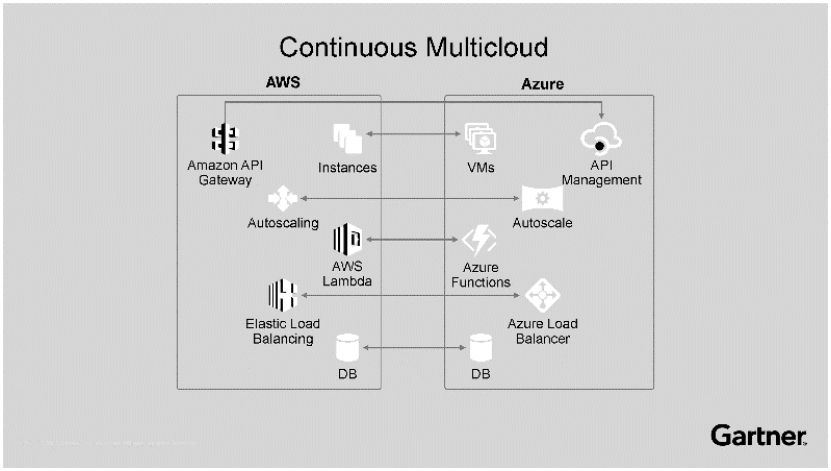
- Multi-cloud Use Case Examples:

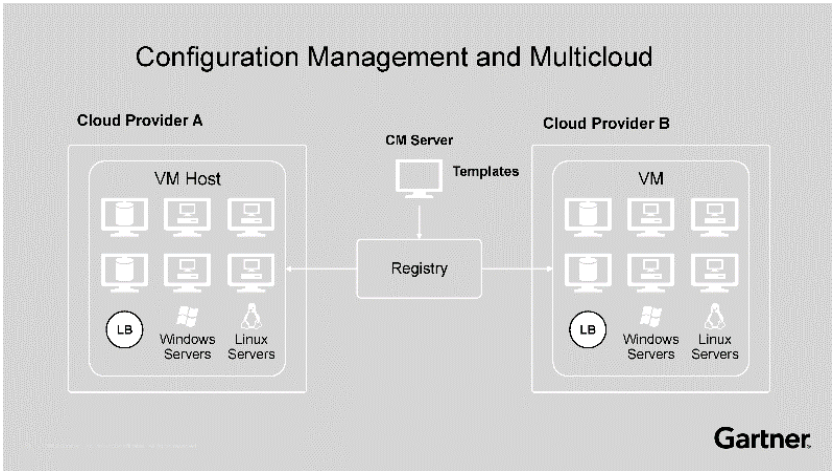







Third-Party PaaS On-Premises and Across Multicloud
Data Center
PaaS Framework
AWS
Azure
Gartner


Continuous Multicloud
AWS
Azure
Amazon API Gateway
Instances
VMs
API Management
Autoscaling
Autoscale
AWS Lambda
Azure Functions
Elastic Load Balancing
Azure Load Balancer
DB
DB
Gartner


Configuration Management and Multicloud
Cloud Provider A
CM Server
Templates
Cloud Provider B
VM Host
VM
Registry
LB
Windows Servers
Linux Servers
LB
Windows Servers
Linux Servers
Gartner

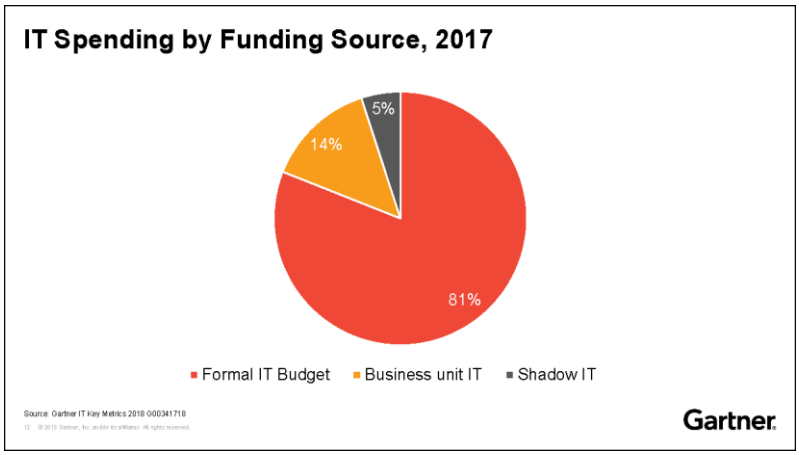
Cloud Computing Governance

Adaptive Governance: Coping with the Challenges of Cloud Computing

Overview

Research and presentation by Mr. Douglas Toombs of Gartner.

- Shadow operations expose organizations to unnecessary risks.



- Principle statements should always be:
  - Relevant – grounded in specific contexts relative to the organization.
  - Actionable – readers must be able to grasp what might be required of them.
  - Clear Implications – noncompliance to core principle should have consequences that are practically self-evident.

- Implementing programmatic controls to enable governance:
  - Five key approaches:
    1. Use native tools and capabilities of the cloud provider(s).
    2. Use third-party software.
    3. Use provider native tools + third-party software.
    4. Use provider native tools + in-house developed tooling.
    5. Use provider native tools + third-party software + in-house developed tooling.
  - Most organizations will end up at #5.

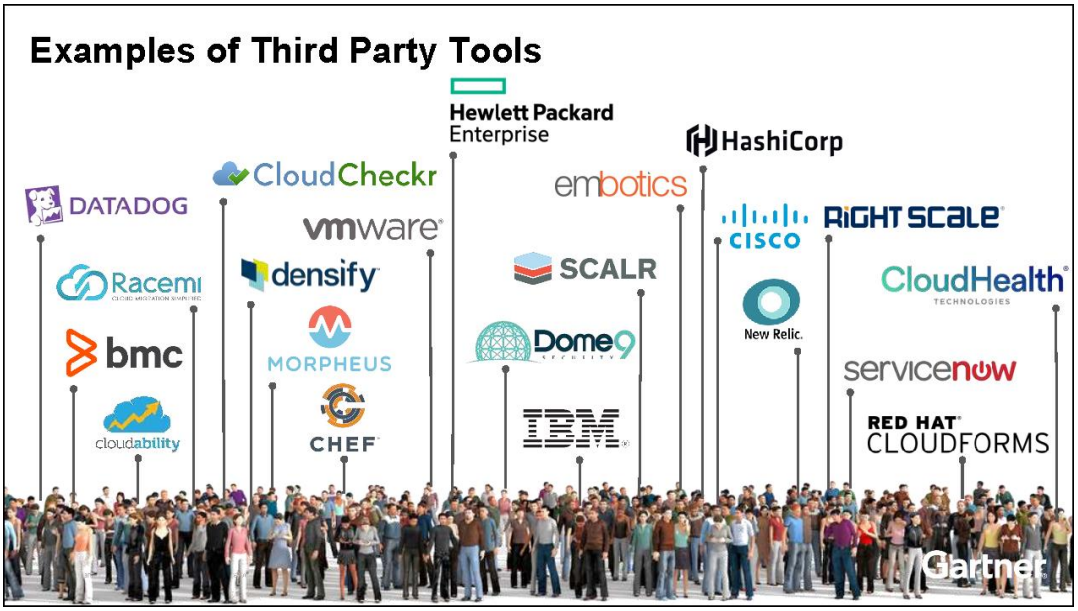
Example of Using Provider-Native Capabilities

Amazon Web Services
Identity & Access Management Policy

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Action": "ec2:*",
            "Resource": "*",
            "Effect": "Allow",
            "Condition": {
                "StringEquals": {
                    "ec2:Region":
                       "eu-central-1",
                       "eu-west-1",
                       "eu-west-2",
                       "eu-west-3"
                }
            }
        }
    ]
}
```

Microsoft Azure
Resource Group Policy

```
{
  "if" : {
    "not" : {
      "field" : "location",
      "in" : ["germanycentral","germanynortheast",
           "germanywestcentral",
           "germanynorth","ukwest", "uksouth",
           "westeurope","northeurope",
           "switzerlandnorth","switzerlandwest",
           "francecentral","francesouth"]
    }
  },
    "then" : {
      "effect" : "deny"
  }
}
```



- IT $$$ is moving outside IT to the business (for VITA that would mean to the agency).

- Principles, Programmatic Controls and Policies:

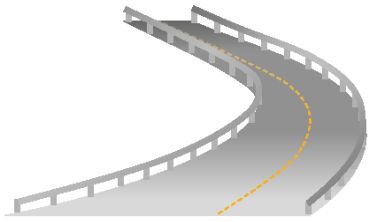
Principles, Programmatic Controls and Policies: An Example

Principle	All organization systems and data should only be accessed by employees or verified subcontractors.
Programmatic Control	LDAP or Microsoft Active Directory will be used to maintain a list of active employees and contractors, and systems shall validate access against this prior to allowing access.
Policy	Business units self-managing solutions that can not integrate with LDAP/AD will be responsible for disabling accounts for terminated employees in a timely fashion. IT will routinely audit for compliance against this policy.

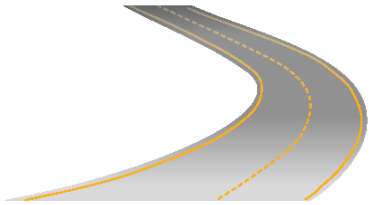
Gartner

Guardrails:
Implemented to stop a bad outcome

Guidelines:
Clearly communicates a risk boundary



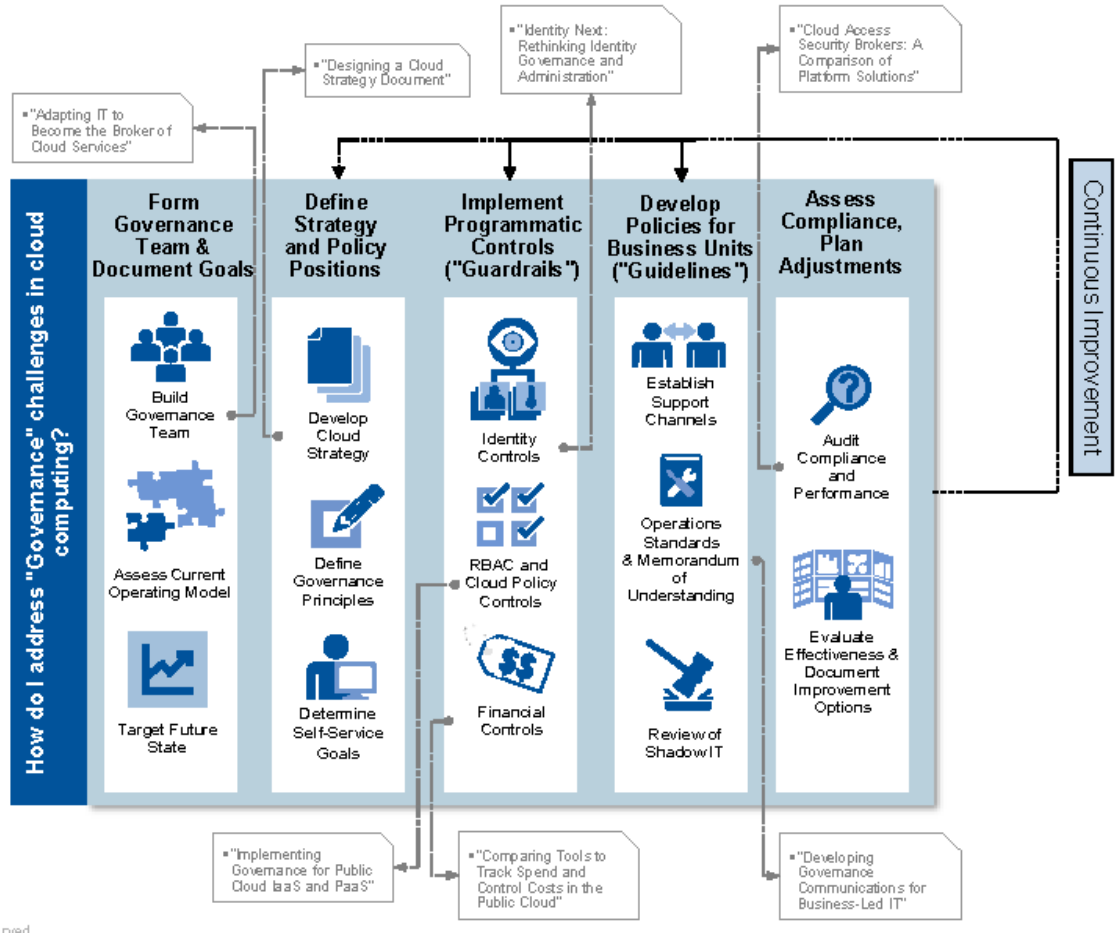
PROGRAMMATIC CONTROLS



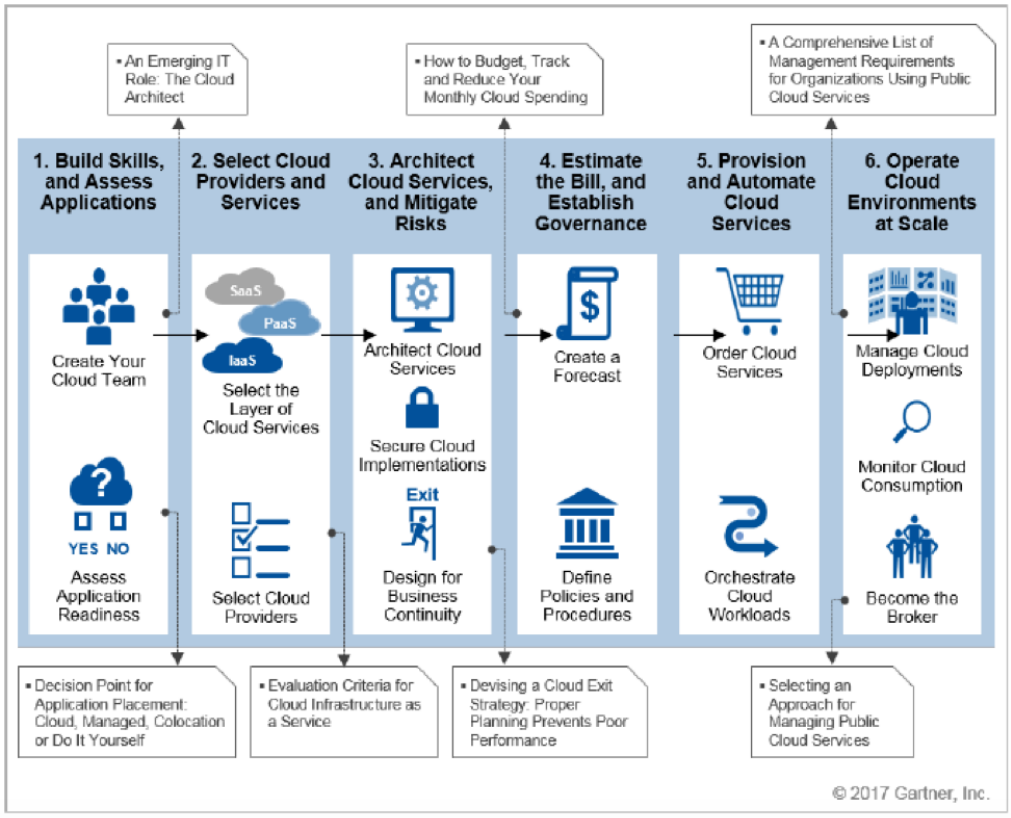
POLICIES

Gartner

- Solution Path for Enabling Governance of Public Cloud Computing:

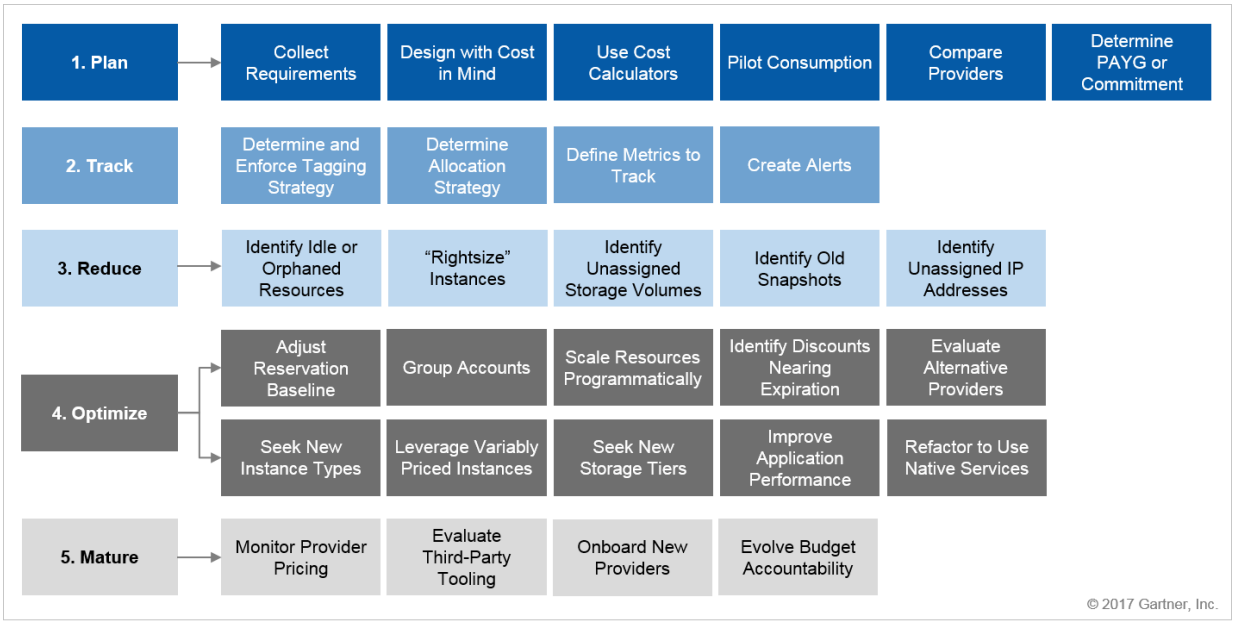


- Gartner Cloud Adoption Framework:



Source: Gartner (September 2017)

- Gartner Multi-cloud Governance Framework:



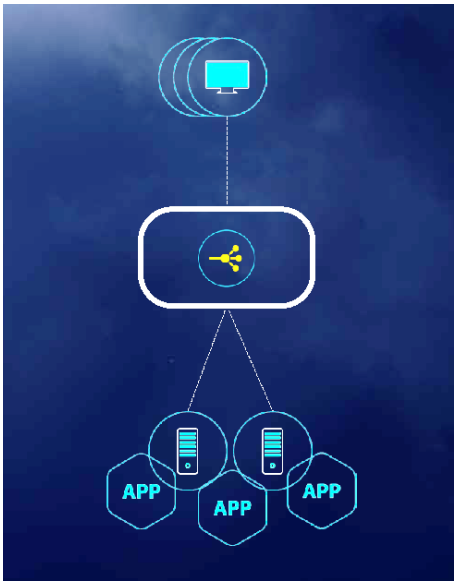
Application Delivery

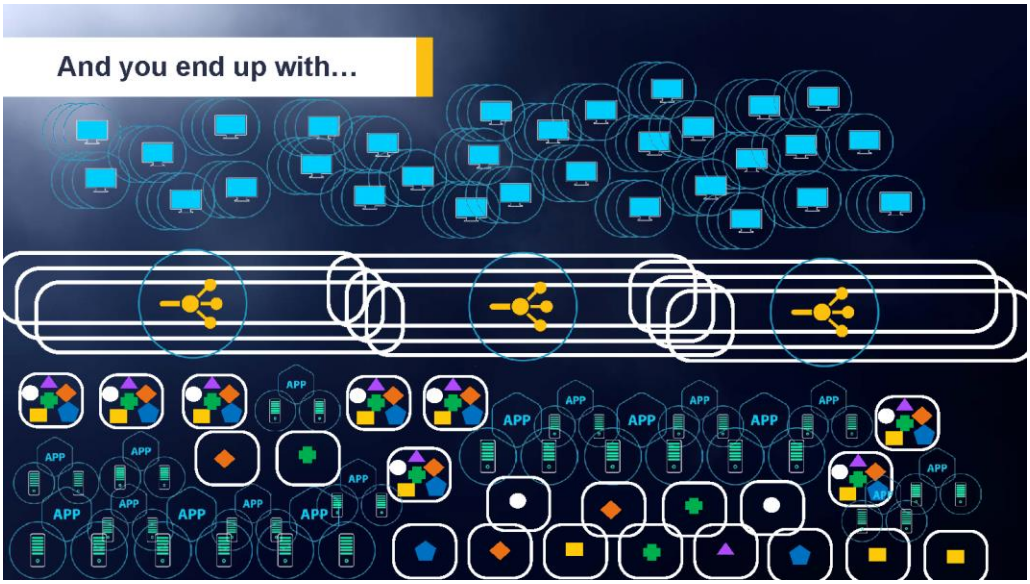
Application Delivery Showstoppers with a Modern Ecosystem

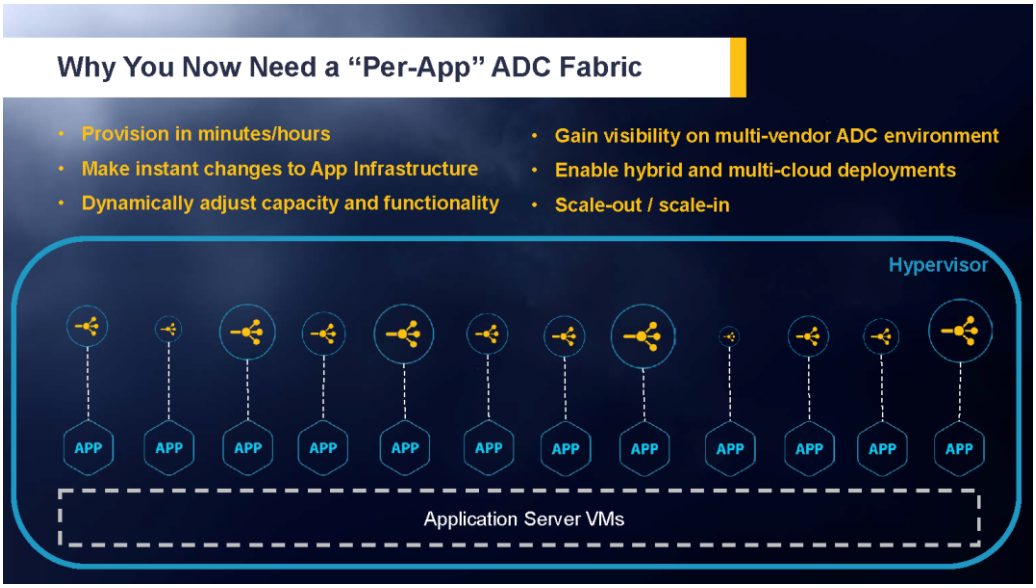
Overview

Research and presentation by Mr. Jason Dover of KEMP Technologies.

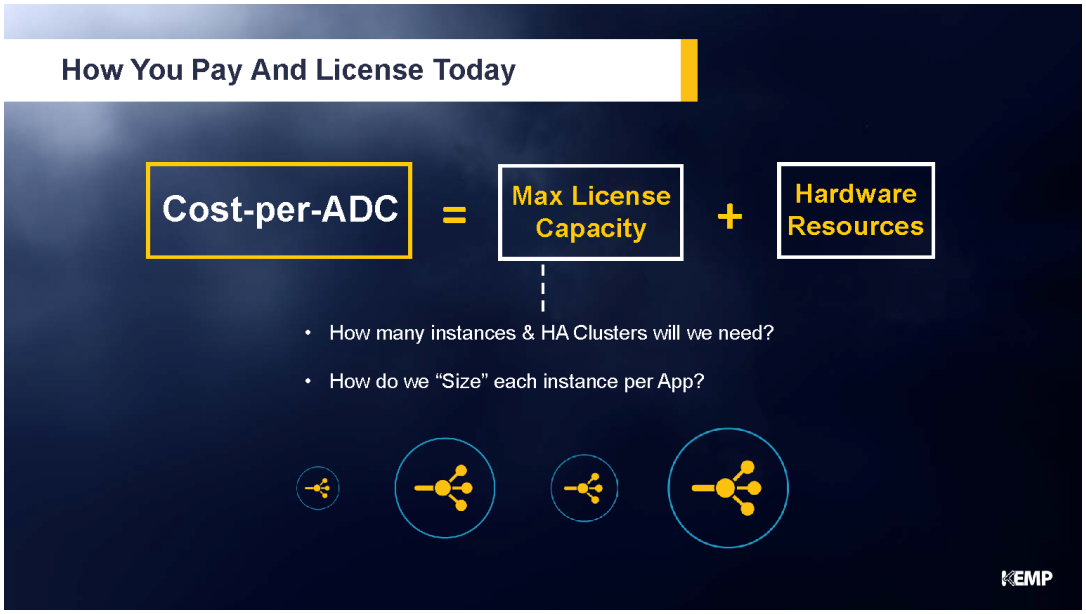
- Three common showstoppers.
  - #1 = Workload Migration to cloud
    - Cloud native, stateless, loose coupling.
    - 50/50 by 2020 in cloud.
    - Cloud apps / On-prem apps.
  - #2 = Evolved Application Architecture (Microservices)
  - #3 = Aligning ADC multi-tenancy to cloud
    - Tighter coupling at physical layer makes it difficult for loose coupling at logical layer.
- ADC scaling = Application Delivery Controller.
- Need a PER-App ADC fabric.
- How your multi-app VM environment might look ahhhhh.
- But apps and VM's easily multiply, along with the addition of container architecture, or even micro-services architecture, and then you end up with this:

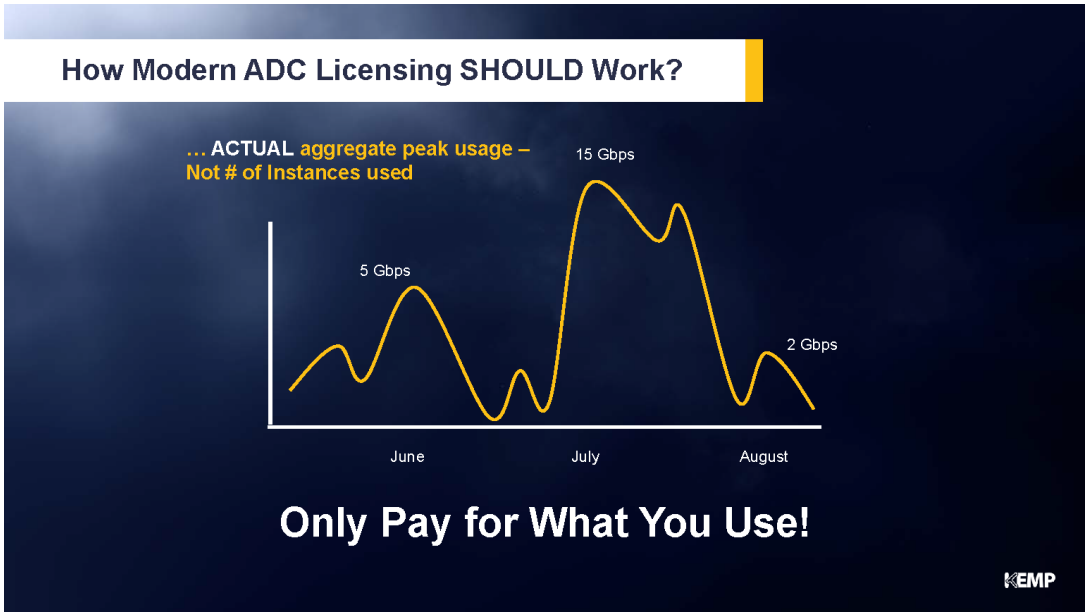



And you end up with…
APP


Why You Now Need a "Per-App" ADC Fabric
Provision in minutes/hours
Make instant changes to App Infrastructure
Dynamically adjust capacity and functionality
Gain visibility on multi-vendor ADC environment
Enable hybrid and multi-cloud deployments
Scale-out / scale-in
Hypervisor
APP
Application Server VMs

- ADC licensing:





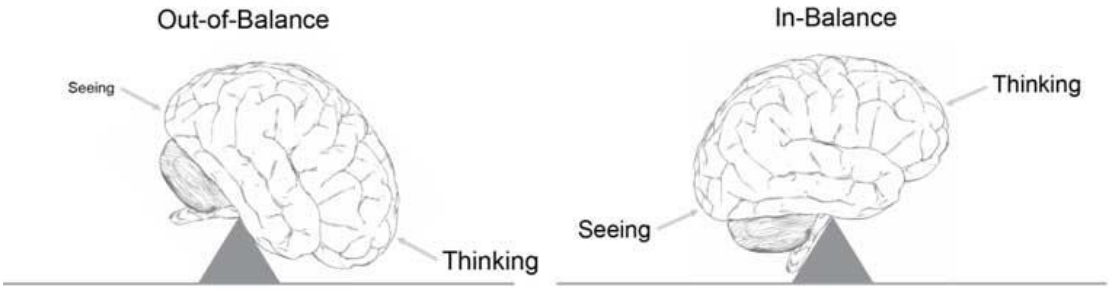
90% of the data present in the world today was created in the last two years alone!

Data Visualization

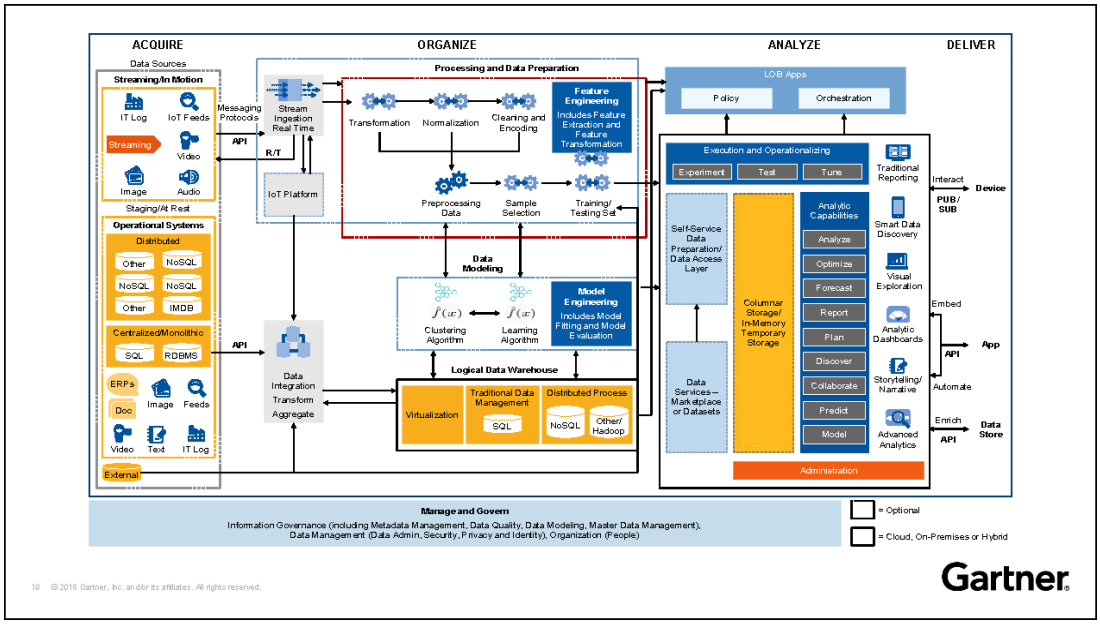
The Future of Data Visualization

Overview

Research and presentation by Mr. Daren Bradham of Gartner.



- Visualization that is already here:

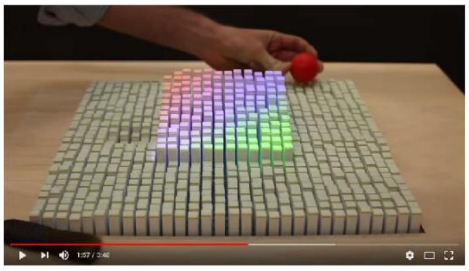


  - A plethora of beautiful charts and graphs.

- There are growing capabilities and culture around self-service business intelligence.
- Ability to deploy data visualization techniques throughout the architecture.

- Three frontiers for tomorrow's data visualization:
  - New avenues for sensing data.
    - Smell
    - Sound Sculpting
      - Non-contact tactile feedback for feel-able 3D shapes.
      - Exploring volumetric slices through tactile shapes.

      - Render a large number of control points in real-time.
      - Increase tactile strength through optimizations.
      - Perform technical and user evaluations.
    - Touch

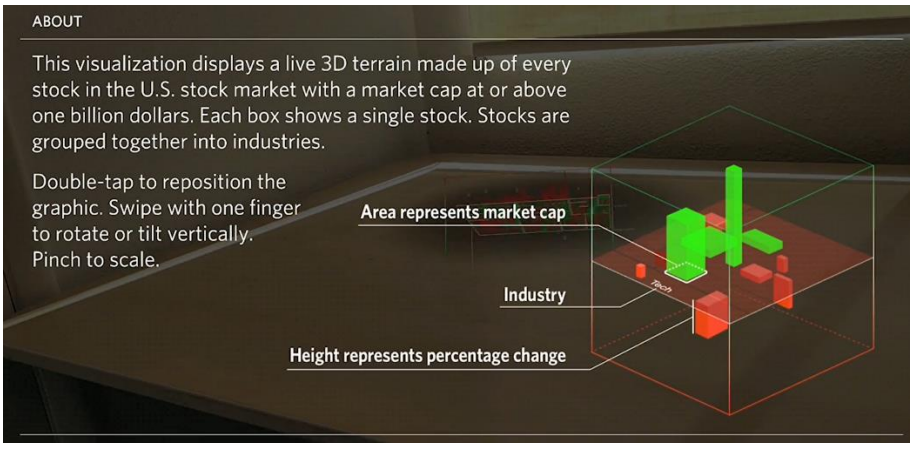


Data Visualization

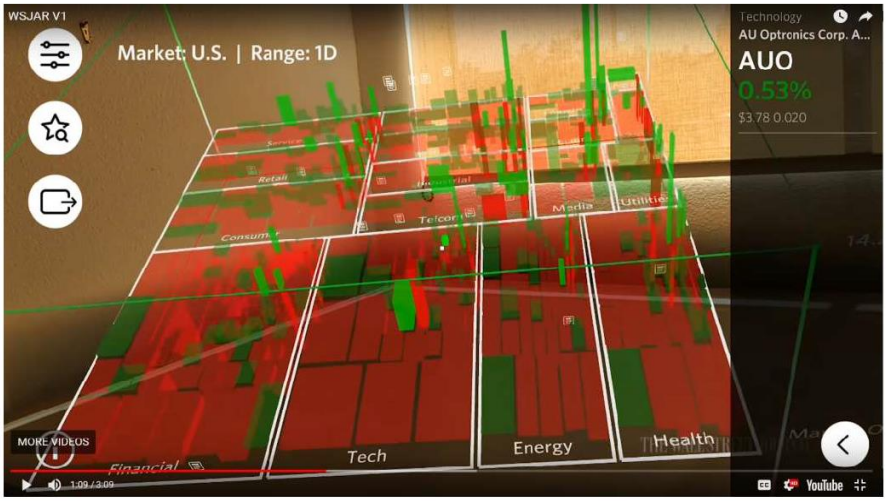
Good visualization can empower, spark invention, and initiate discoveries.

Source: MIT Media Lab Tangible Media Group. https://tangible.media.mit.edu/project/inform/

  - New exploratory tools.
  - Data visualization to make breakthroughs.
- Challenges implementing big data analytics in a better way include:
  - Tools are hard to master.
  - Scalability.
    - Companies find it difficult to scale up resources and human capital to meet big data projects that have grown exponentially.
  - Actionable insights.
    - Difficult to directly correlate higher volume of big data with better insights.
      - Primary issue is lack of cohesiveness amongst stakeholders and data scientists.



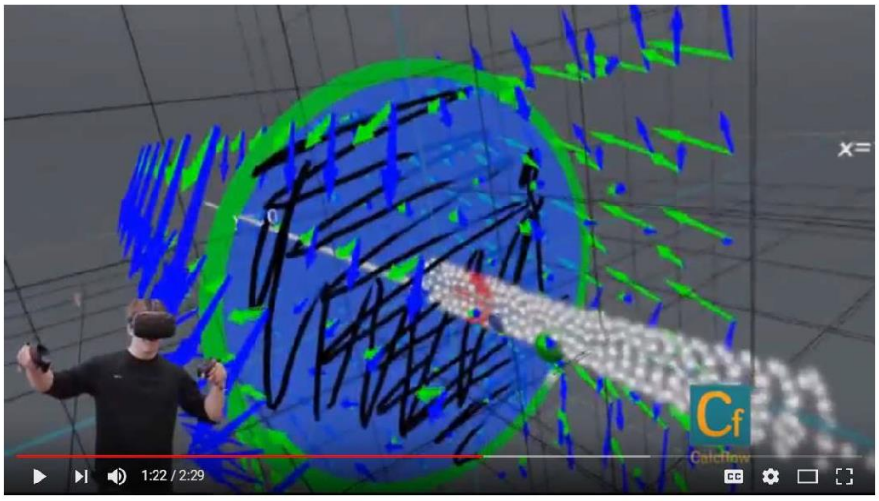
Data Visualization



Source: Emblematic Group, http://emblematicgroup.com/experiences/dow-jones/

Gartner

- Augmented Reality (AR) helps to overcome the problems of limited human perception and limitations from dimensions and screen sizes when analyzing big data.
    - The problem of scaling for actionable insights is solved effectively by AR.



Source: Calcflow, https://store.steampowered.com/app/547280/Calcflow

Gartner

Data Visualization

Data visualization means making data more digestible and actionable for people.

Get inspired with visualizing data!

- Keep in mind that sometimes a 3D graphic is not the best visualization for some aspect of data.
- Sensing = More than eyesight – includes sound, touch, etc.
- http://biaynabogosian.com/research

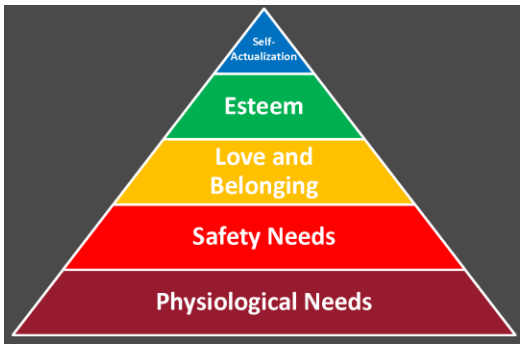
Multi-Cloud Resiliency

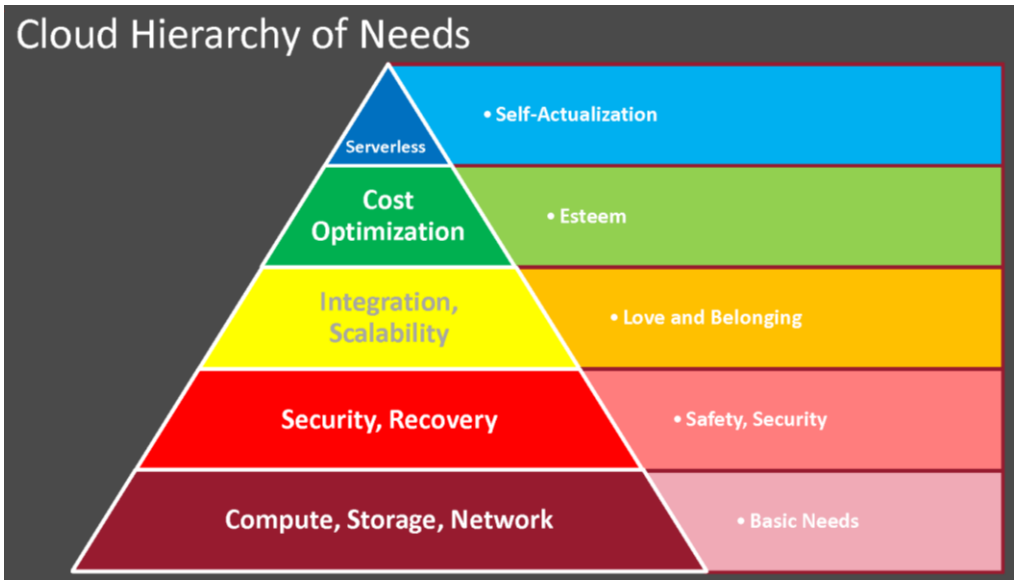
Resiliency for Every State of Your Multi-Cloud Journey

Overview

Research and presentation by Mr. Andrew Stone and Girish Dadge of Sungard Availability Services.

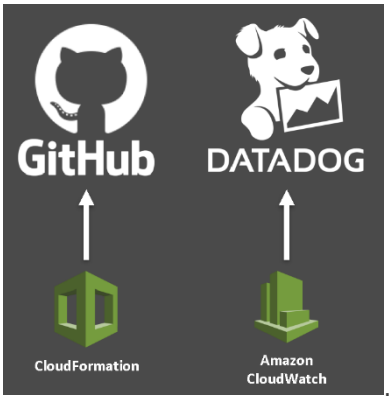
- Took the hierarchy of needs and applied it to multi-cloud resiliency.





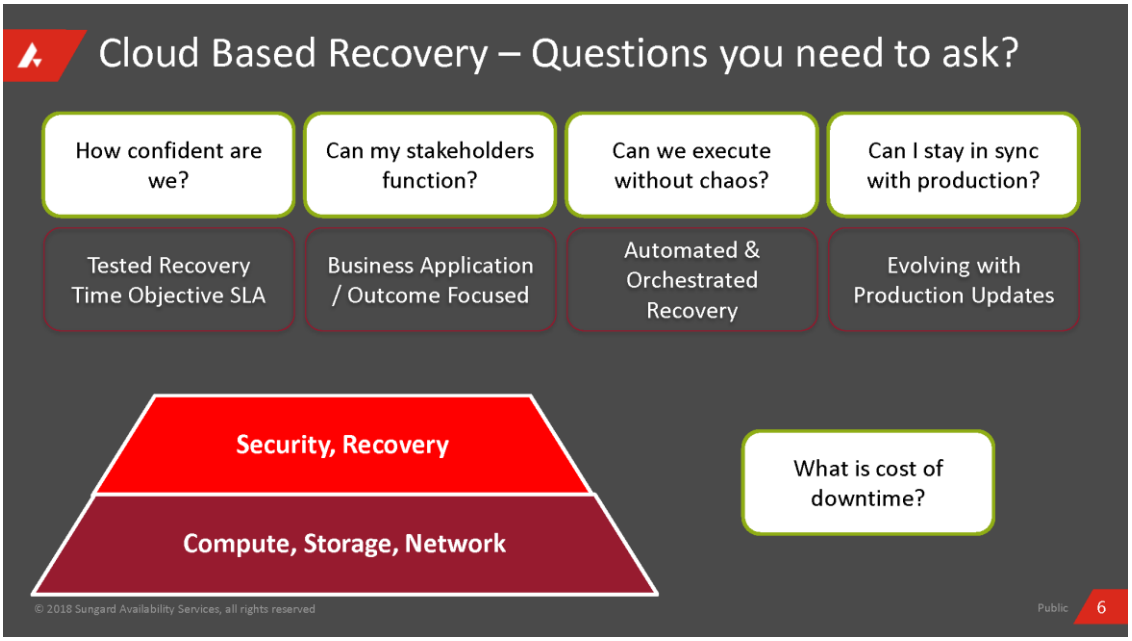
- Use GitHub for CloudFormation and DataDog for Amazon CloudWatch for integration and scalability.

Multi-Cloud Resiliency



- CloudChecker and Spotinst to check in cost optimization in production.

- Questions to ask for cloud-based recovery:



Cost comparing is not needed as a metric as they're all three about the same.

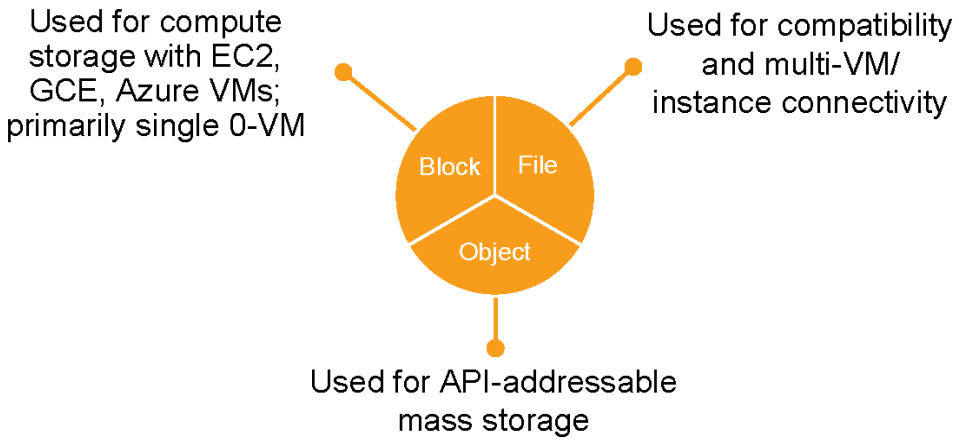
Cloud Storage

Comparing Cloud Storage – Amazon, Google, and Microsoft.

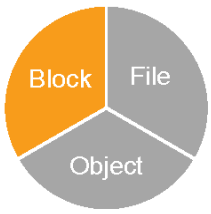
Overview

Research and presentation by Ms. Angelina C. Troy of Gartner.

- Cloud storage services:

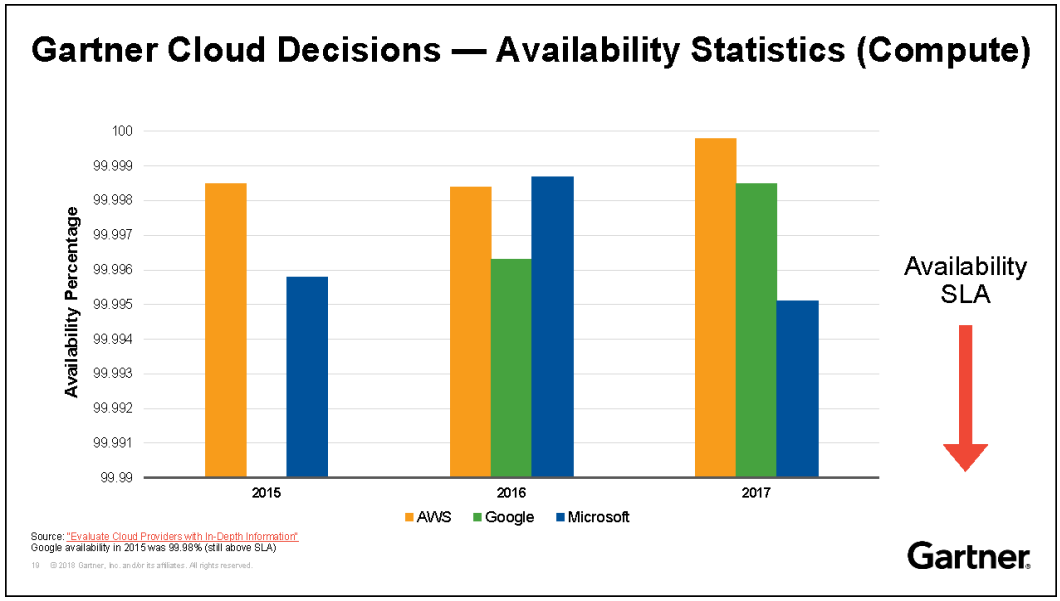


- What block storage services are available?



Block Storage Services			
Vendor Platform	Amazon Web Services	Microsoft Azure	Google Cloud Platform
Persistent SSD	EBS gp2 – General Purpose EBS io1 – Provisioned IOPS	Premium Managed Disk	Persistent Disk (SSD)
Persistent HDD	EBS st1 – Throughput Opt. EBS sc1 – Cold HDD	Standard Managed Disk	Persistent Disk (HDD)
Ephemeral Storage	EC2 Instance Store	VM Local Storage	GCE Local SSD

- Google Cloud Platform (GCP) has the largest volumes and highest noncached IOPS.
- Microsoft Standard has the highest latency, but supports caching.
  - Also has a new SSD option called, “Standard SSD” that should contribute to reduced latency
  - Caching can make up for higher latencies and lower throughput using persistent HDD.
- Block storage availability statistics:

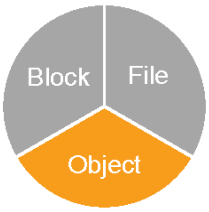


- Persistent HDD has considerably lower capacity cost than persistent SSD.
- Leverage Gartner’s data and methods for testing.
- Balance compute and storage resources:
  - Compute instance selection is every bit as important as storage selection.
- Do not oversize volumes or select compute instances that are too small.
  - Volumes have performance maximums, but so do compute instances.
- Select persistent HDD services where possible:
  - Many workload do not require SSD performance.
  - This is an opportunity for significant cost savings.
- Set up snapshot management through serverless functions.

Cloud Storage

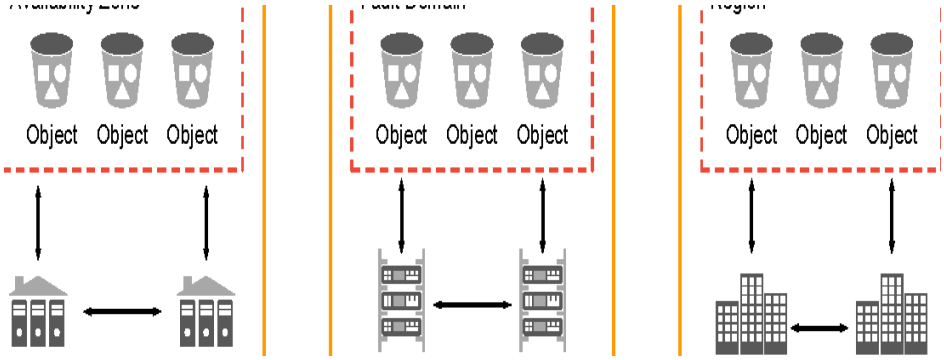
Data is your responsibility not theirs – if it gets lost in the cloud then it's on you, so plan accordingly...

- What object storage services are available?



Object Storage Services			
Vendor Platform	**Amazon Web Services**	**Microsoft Azure**	**Google Cloud Platform**
High-Usage Services	Amazon Simple Storage Service (S3)	Hot Storage (LRS, ZRS, GRS, RA-GRS)	Google Cloud Storage (GCS)
Mid-Usage Services	Amazon S3 Standard Infrequent Access (S-IA) Amazon S3 One-Zone Infrequent Access (Z-IA)	Cool Storage (LRS, ZRS, GRS, RA-GRS)	GCS Nearline
Low-Usage Services	Amazon Glacier	Archive Storage (LRS, GRS, RA-GRS)	GCS Coldline

  - Data distribution design in object storage:

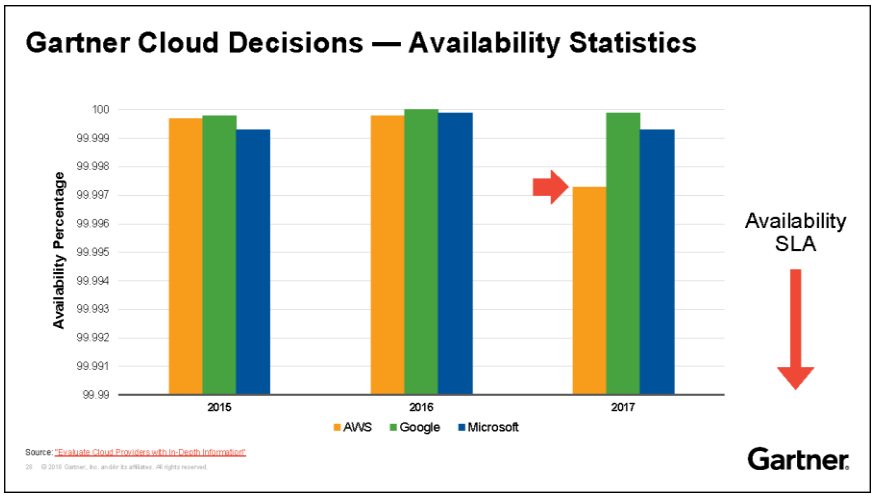


  - Data distribution in object storage:

Provider	Multiple Zone	Single Zone
AWS	S3 Glacier	S3 Z-IA
Google	Multi-Regional* Regional	N/A
Microsoft	ZRS GRS/RA-GRS**	LRS

- Eleven-9's durability although no durability SLA.
- Options are available for multiple regions:
  - CRR for AWS
  - Multi-regional for Google
  - GRS for Microsoft
- Versioning for AWS and Google.
- Snapshots for Microsoft.

- Object storage availability statistics:



- Performance depends on the instance accessing data:
  - Larger instances generally have more throughput.
  - Google allows higher throughput for small instances.
  - Latency is under 1ms (often 0.5ms) for high- and mid-usage.
    - Low-usage is measured in minutes or hours (except Google).
  - AWS has the most consistent throughput.
  - Google has the highest small instance performance, but a lower large instance performance.
  - Microsoft has the highest potential throughput but also highest variability:
    - Note: Latency had to be measure between VMs due to testing method.
- Object Performance Statistics:

Cloud Storage

Object storage cost is more than just capacity pricing...

Provider	Latency
AWS	0.301 ms
Google	0.355 ms
Microsoft	N/A*

Provider	Small Instance	Large Instance
AWS	608 MBps +/- 70 std. dev.	2,569 MBps +/- 69 std. dev.
Google	1,743 MBps +/- 207 std. dev.	1,849 MBps +/- 101 std. dev.
Microsoft	754 MBps +/- 128 std. dev.	3,509 MBps +/- 599 std. dev.

Source: "Evaluate Cloud Providers with In-Depth Information"

*Testing methodology not possible in Microsoft Azure
AWS Instances: c5.large and c5.18xlarge
Google Instances: n1-standard-2 and n1-standard-64
Microsoft Instances: D2 v3 and D64 v3

- Object Storage Costs:

Service Class	Capacity Cost per GB per Month	PUTs/Month	GETs/Month	Data Retrieval	Egress
High-Usage	First nonfree tier	250	1,000	1 GB	100 MB of first nonfree tier
Mid-Usage	First nonfree tier	500	500	500 MB	50 MB of first nonfree tier
Low-Usage	First nonfree tier	100	10	10 MB	1 MB of first nonfree tier

- Object Storage Highlights
  - AWS
    - Amazon S3 and Amazon Glacier use different APIs.
    - Amazon Glacier does not have an availability SLA.
    - Amazon Macie can detect sensitive date in S3 / Glacier.
    - S3 Select and Glacier Select can return a subset of an object.
  - Google
    - Multi-regional does not expose the regions it uses.
    - Public objects are automatically cached con the edge network

- GCS Coldline latency is the same as high- and mid-usage.
- Small instance performance is quiet good by comparison
- Transfer Service can pull data from arbitrary HTTP/HTTPS locations into GCS buckets.

▪ Microsoft

- Not S3 API compatible by default (must use workarounds)
- Archive Storage does not have ZRS or an availability SLA
- Archive Storage early deletion fee is 180 days, no 90 days
- Can update portions of an object rather than in whole
- Azure Stack has interesting future potential for distribution and tie5ring capability.

○ Recommendations for Object Storage:

▪ While the standard service class has the lowest operational cost, a large percentage of the typical organization's data isn't operated on so be sure to align the use case to the appropriate service class.

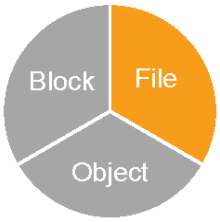
▪ Control storage sprawl to avoid sticker shock

- Focus on timely data deletion and data life cycle.
- Determine when and if data should be deleted.

▪ Focus on operational aspects to differentiate services:

- How can the service simplify your life and data management?
- Determine the full cost including operations, retrievals, and egress.

- What File storage services are available?



File Storage Services			
Vendor Platform	Amazon Web Services	Microsoft Azure	Google Cloud Platform
NFS Storage	Amazon Elastic File System (EFS)	N/A*	Google Filestore (preview)
SMB Storage	N/A	Azure Files	N/A

These File Services Are Quite Different

	Amazon EFS	Google Filestore	Microsoft Azure Files
File Protocol	NFSv4.1	NFSv3	SMB 2.1/3.0, NFSv3/4.1 (on-prem)
Pricing per Month*	$0.30 per GB	$0.20 per GB (standard) $0.30 per GB (premium)	LRS: $0.06 per GB ZRS: $0.075 per GB GRS: $0.10 per GB plus operations cost***
Data Distribution	Across AZs	Within one AZ	Within one AZ (LRS) Across AZs (ZRS) Across Regions
Max Capacity (per share)	PBs+	64 TB	5 TB
Max IOPS (per share)	Performance based on throughput	5,000 (standard) 30,000 (premium)	1,000
Maximum Throughput (per share)	1 GB/s or 3 GB/s (depends on region)	180 MB/s (standard) 700 MB/s (premium)	60 MB/s

*Based on U.S. pricing
**Based on Gartner testing
***From $0.0015 to $0.03 per 10,000 operations depending on type of operation

Gartner

Each Hits a Different Cross-Section of Use Cases

	Amazon EFS	Google Filestore	Microsoft Azure Files
App Migration	✓	✓	✓
Big Data Analytics	✓		
Content Management	✓	✓	
Home Directories	✓	✓	✓
Hybrid IT Storage			✓
Media Processing	✓	✓	

- Amazon EFS has a mechanism to move data into Amazon EFS as needed
- Microsoft can cache Azure Files data into on-prem Windows Servers
- EFS-to-EFS Backup and Azure Files Snapshots can provide data protection

Per AWS, Google and Microsoft documentation

Gartner

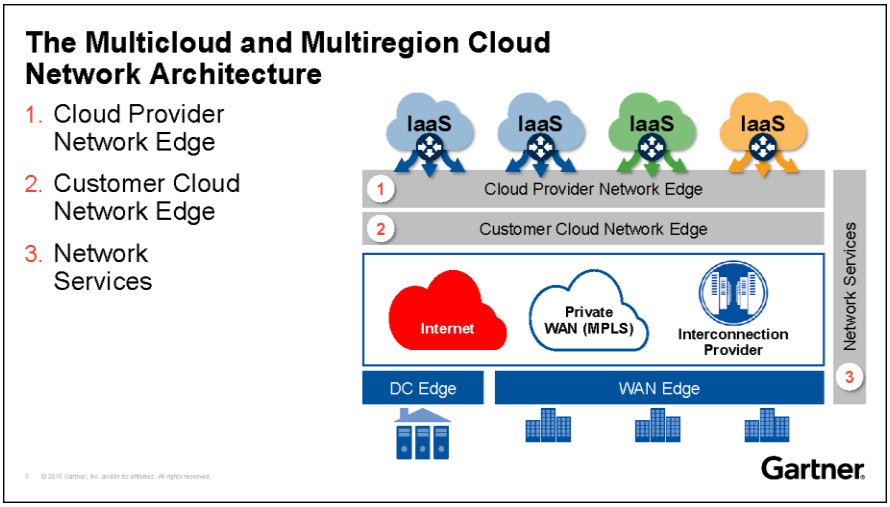
- Recommendations for Cloud Storage in General:
  - No provider or service is the best overall.
  - Don’t forget to encrypt your data – no significant performance hit doing so.
  - Remember that you’re data is your responsibility.

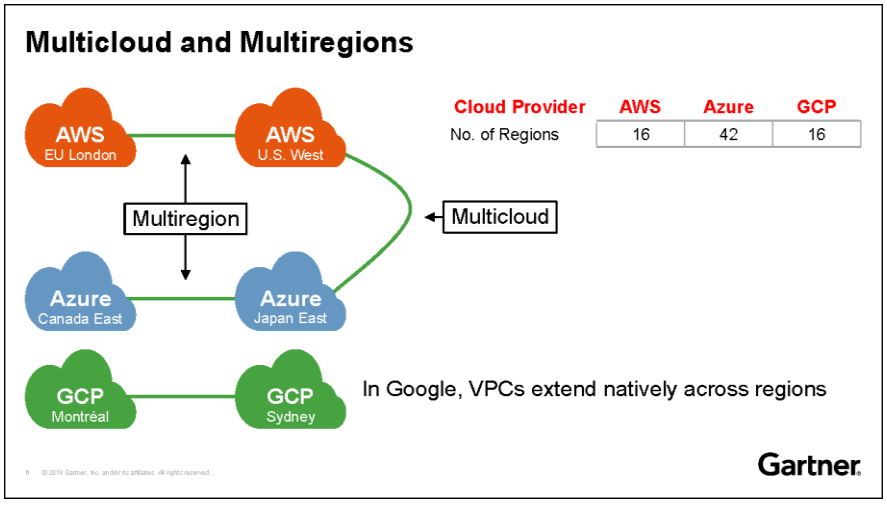
Multiple Cloud Networking

Networking Across Multiple Regions and Clouds

Overview

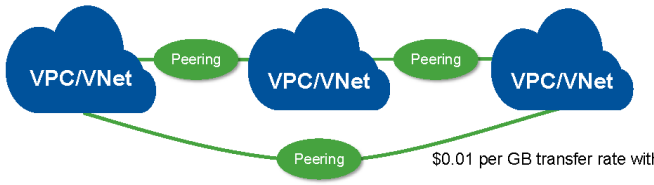
Research and presentation by Mr. Simon Richard of Gartner.





Multiple Cloud Networking

VPC Peering and VNet Peering



VPC-peering and VNet-peering is now the preferred connectivity across regions for AWS and Azure. In Google, global VPC are preferred.

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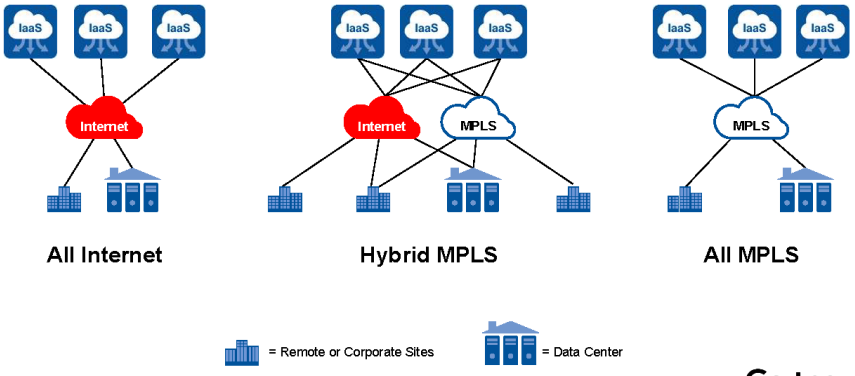
The WAN Topology Spectrum



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Multiple Cloud Networking

	AWS	Azure	Google
Internet Egress	Cost depends on the region and the bandwidth used per month. Updated pricing is available here	Cost depends on the source region and the bandwidth used. Updated pricing is available here	Cost depends on the source region and the bandwidth used. Updated pricing is available here
Cross-Region Traffic	Cost depends on the egress region. $0.02/GB in North America and Europe. Special pricing between U.S. East (N. Virginia) and U.S. East west/central? (Ohio) at $0.01/GB. Updated pricing is available here	Same as Internet egress cost.	Egress with region in the U.S. at $0.01/GB. Egress outside the U.S. at Internet egress rates.
Inter-region VPC and VNet Peering	Same cost as inter-region cross-region? Traffic	VNet ingress and egress costs are charged on both sides of the connection, based on the region. Updated pricing is available here	Same as Internet egress cost.
Private Interconnect Data Transfer Cost	Egress traffic charges only. Depends on the source AWS Region and AWS and Direct Connect location. Varies from 2¢/GB within U.S. to 19¢/GB from Australia to South Africa. Updated pricing is available here	Egress traffic charges only. Varies from 2.5¢/GB from North America to where? Also offers unlimited data plans. Updated pricing is available here	Egress traffic charges only. Depends on the source region. Varies from 2¢/GB from within the US to 42¢/GB in Australia. Updated pricing is available here

Gartner

Recommendations

- ✓ Create VPC and VNet transit network, managed by NetOps, to connect regions and providers.
- ✓ Leverage VPC and VNet peering for region to region connectivity within a provider.
- ✓ Build a cloud edge leveraging a colocation-hub when using more than one MPLS network carrier. Once built, decide which functions to centralize in the cloud edge instead of duplicating them in each of the cloud providers.

Gartner

Implementing virtual desktops where they don't belong will guarantee failure and user distrust.

Virtual Desktops

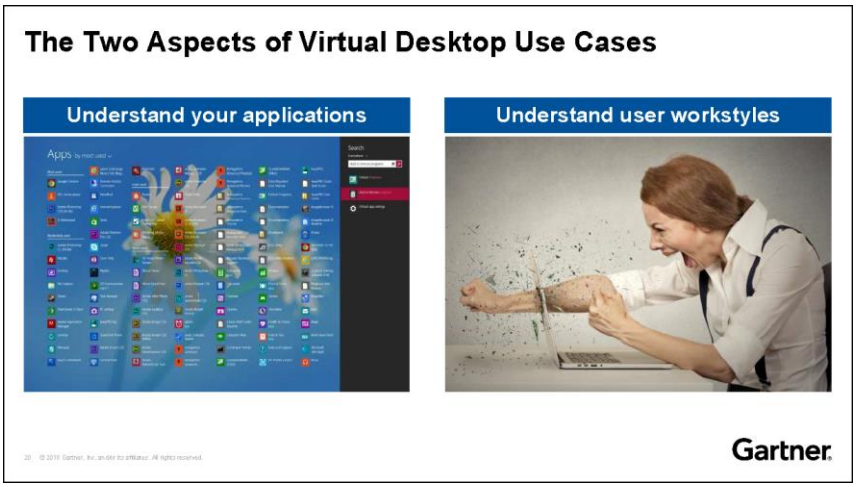
VDI, DaaS, or Hybrid? The Best Virtual Desktop Approach for Your Business

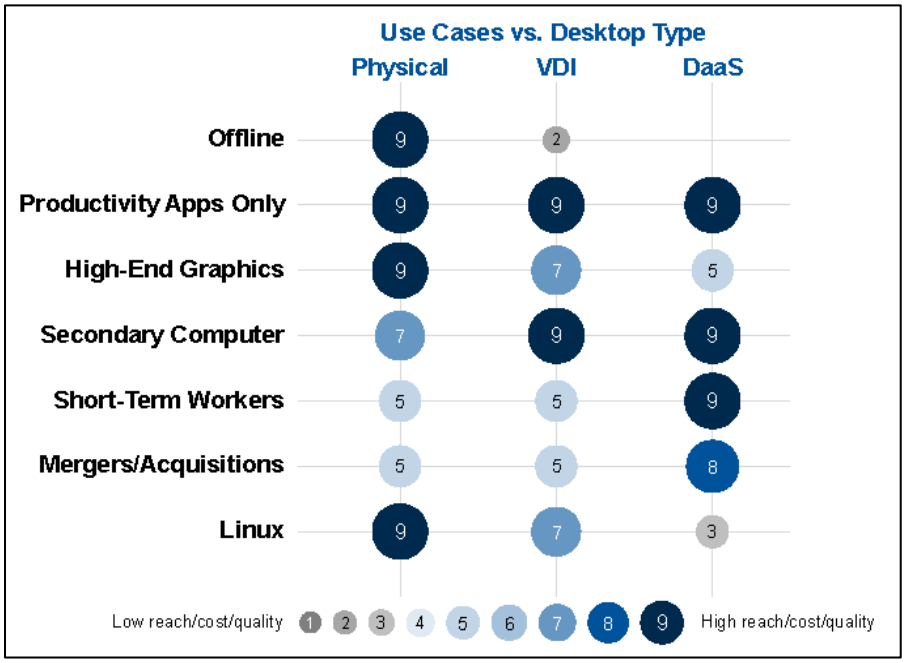
Overview

Research and presentation by Mr. Mark Lockwood of Gartner.

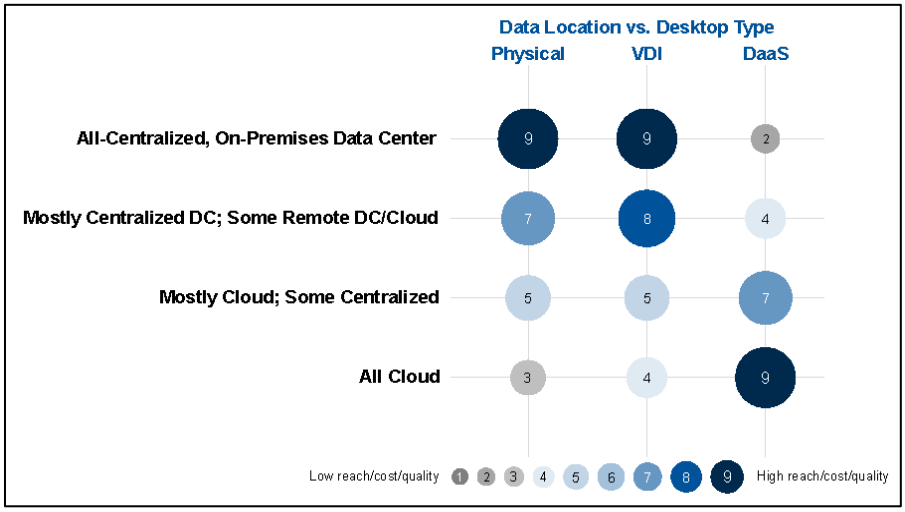
- VDI = On-premises hosted
  - On-premises-hosted infrastructure and virtual desktops, control plane in cloud or on-premises – designed by you and managed by you.
- DaaS = Cloud-hosted
  - Desktop-as-a-Service cloud-hosted infrastructure and virtual desktops, control plane in cloud – designed by cloud vendor, managed by cloud vendor and you.
- Hybrid = On-premises-hosted and cloud-hosted
  - On-premises and cloud-hosted infrastructure, control plane in cloud – designed and managed in both ways.
- Need to ask yourself five questions for VDI:
  - What are you trying to accomplish?

  - What are my use-cases?
  - Where are my users?
  - Where is my data?
  - What is the cost?
- Managing the performance of VDI is tricky and is the most sensitive to change.
- There is no magic number for a VDI implementation in an organization – could be 10% or could be 100%.
- VDI and DaaS is highly susceptible to a user breakage.
- Have to segment user base on how they use their desktops when figuring out what would be the best deployment of a VDI solution throughout the organization.
- Really have to watch graphics with VDI and DaaS.
- What are you trying to accomplish?
  - Server virtualization does not equal VDI success.
  - Cloud IaaS success does not equal Desktop-as-a-Service (DaaS) success.
  - Common reasons to implement VDI:
    - Overcoming distance
    - Enhanced data security
    - Centralization
    - Non-persistence
  - Common reasons to implement DaaS:
    - Overcoming distance
    - Proximity to cloud apps
    - Elimination of complexity of VDI
    - Move to OPEX cost model
    - Elasticity
- What are my use cases?
  - What use cases fit?

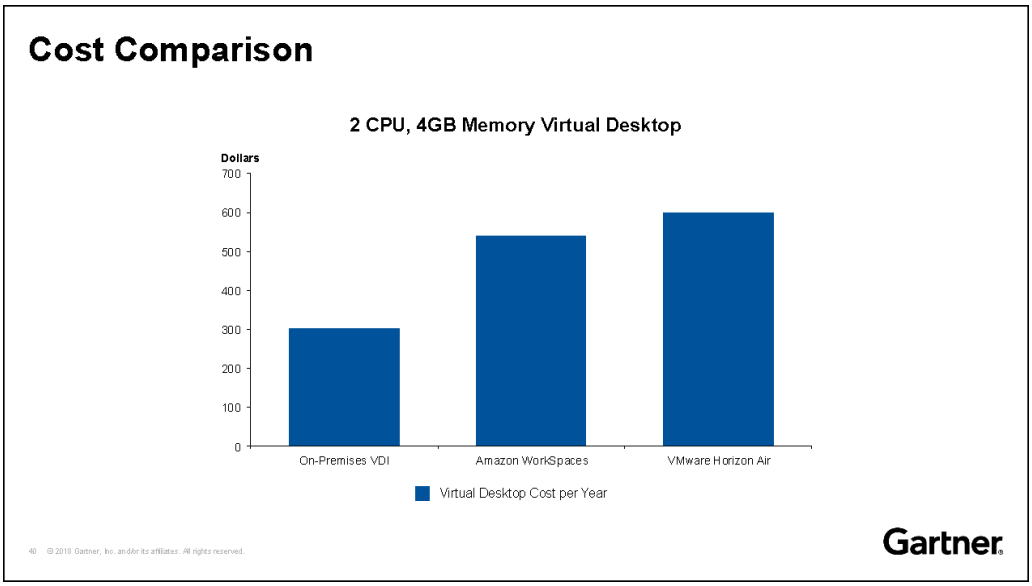




- Where are my users?
  - User location determines use experience.
    - Further away user is from the data location, then higher latencies incurred resulting in lower user productivity, and negative experiences
- Where is my data?
  - Data needs to follow your users



- What is the cost?



  - VDI does not save money over physical deployments – 15%-20% more than physical desktop deployments.
  - Must be able to explain the value that virtual desktops bring that makes additional cost worthwhile.
  - Choose DaaS to reduce upfront capital costs and management costs, and to allow for elasticity and highly distributed workforce.
  - Choose VDI for greater data access speed, a larger ecosystem, and more control over your virtual desktop environment.
  - Centralization is a great use case for VDI.
  - Non-persistence is a huge value for VDI.
  - Choose a hybrid solution (VDI and/or DaaS) when you have significant use cases for both VDI and DaaS.
  - Choose to remain on physical systems if neither DaaS nor VDI offer obvious productivity and security enhancements.
  - Do not rush! There are many, many ways to fail with desktop virtualization; slow and steady… wins!
- No one answer is right for all scenarios.
- Remember that physical could be the right choice.
- The best desktop for IT may be a total failure for users.

Virtual Desktops

- DaaS (Desktop as a Service) is managing to an SLA.
- Elasticity = pay for desktops needed only when used.
    - For example, tax preparation occurs five months out of the year then no need to pay for idle resources for the rest of the year.
- Data for DaaS = Data users manipulate.

Perfection is the enemy of done.

Agile Skills and Practices

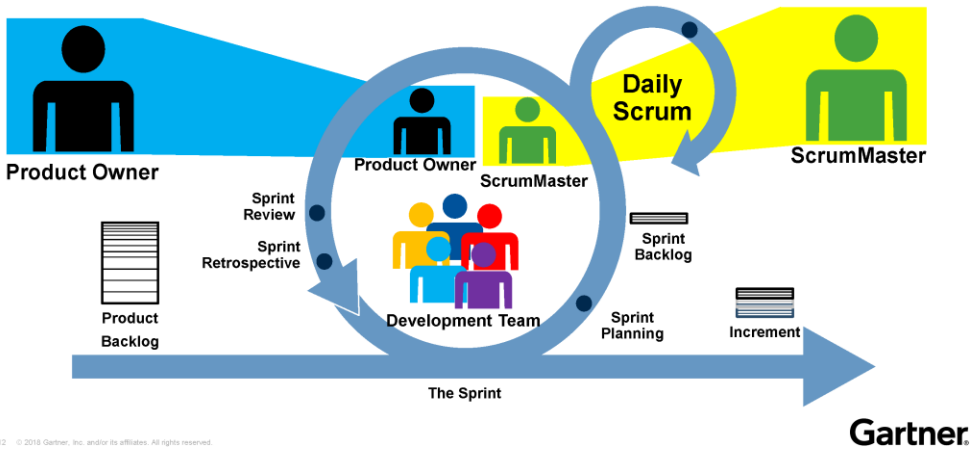
Become an Agile Superhero: Skills and Practices to Succeed

Overview

Research and presentation by Mr. Bill Holz of Gartner.

- Team is accountable.
- SME will hinder agility – all have to be the “expert” / multi-skilled.

The Scrum Framework

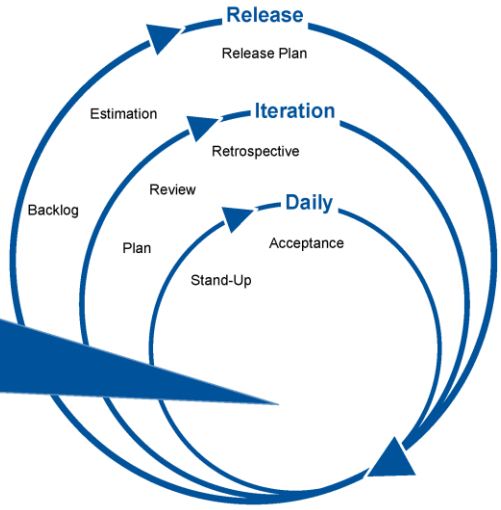


- Mature agile team may not need a full time scrum master.
- 90% are doing scrum if they’re doing agile.

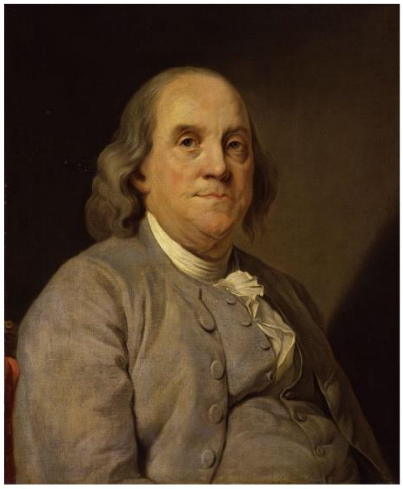
Scrum Is Not Enough

Scrum "is a framework within which you can employ various processes and techniques."

- The Scrum Guide



- Two people coding together has been shown to be quicker.
- No bigger waste than delivering the wrong thing.
- Rework is waste.
- Amazon is a DevOps company.



"I have experienced many instances of being obliged by better information, or fuller consideration, to change opinions even on important subjects, which I once thought right, but found to be otherwise."

Gartner

Gartner recommends making cloud the default deployment option for enterprise database systems.

Operational Databases

Choosing the Right Cloud Platform for the Next Generation of Operational Databases

Overview

Research and presentation by Ms. Lyn Robinson of Gartner.

Comparing On-Premises and Cloud Database Platforms

		26 stars	54½ stars	54 stars
Database		On-Prem.	AWS	Azure
Power	Portfolio of Data-Related Services	★	★★★★★	★★★★
	Performance and Scalability	★★	★★★★	★★★★
	Geographic Footprint	★★	★★★★★	★★★★★
	Managed Private Cloud	★	★	★★★
	Vendor Neutrality	★★	★★★	★★
Development	New Paradigms for Development	★★	★★★★★	★★★★★
	Database DevOps	★★	★★★	★★★
	Ease of Database Migrations	★★	★★★★	★★★
	Learning Curve	★★	★★	★★
Operations	Operational Burden	★★	★★★★½	★★★★★
	Price Controls and Billing Options	★	★★★★★	★★★★★
	Monitoring and Alerting	★★★	★★★★★	★★★★★
	Rightsizing Database Services	★	★★★★	★★★★
	Disaster Recovery, Backup/Restore	★★★	★★★★	★★★★

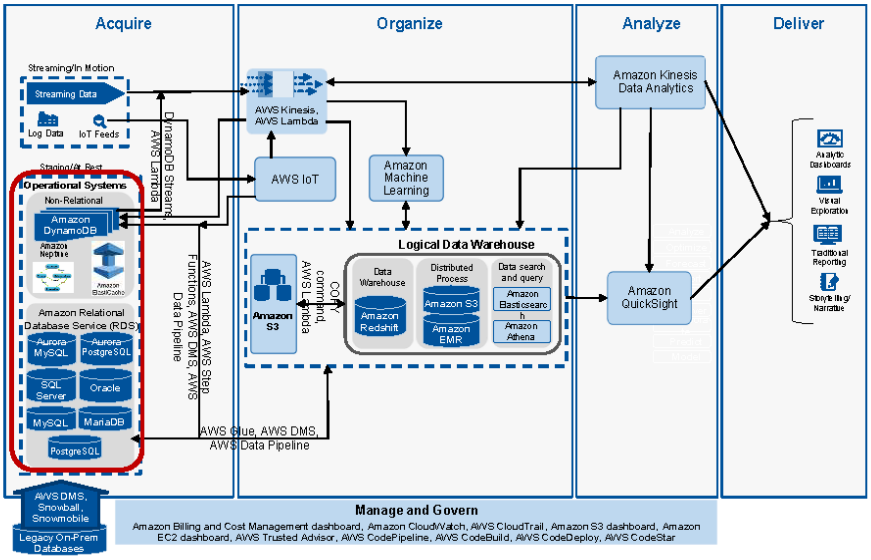
Gartner

- CosmoDB (Azure) is used in speed and persistence layer.
- A noSQL database is different than an on-premise database.
- DynamoDB for AWS is preferred.
- Data consistency is problematic for both CosmoDB and DynamoDB.
- Cloud databases are not perfectly elastic – you have to preprovision their capacity and watch to see if you have provisioned enough.
- Hot pathing = speed path.
- Cold path = persistence path.
- AWS setup function = overall program logic.
- API-in-the-sky is like pie-in-the-skyyyyy.

- LA= Logic App.
- Use strategic vendor approach for database cloud choices.
- Homogeneous = moving from Oracle on-premise to Oracle cloud.

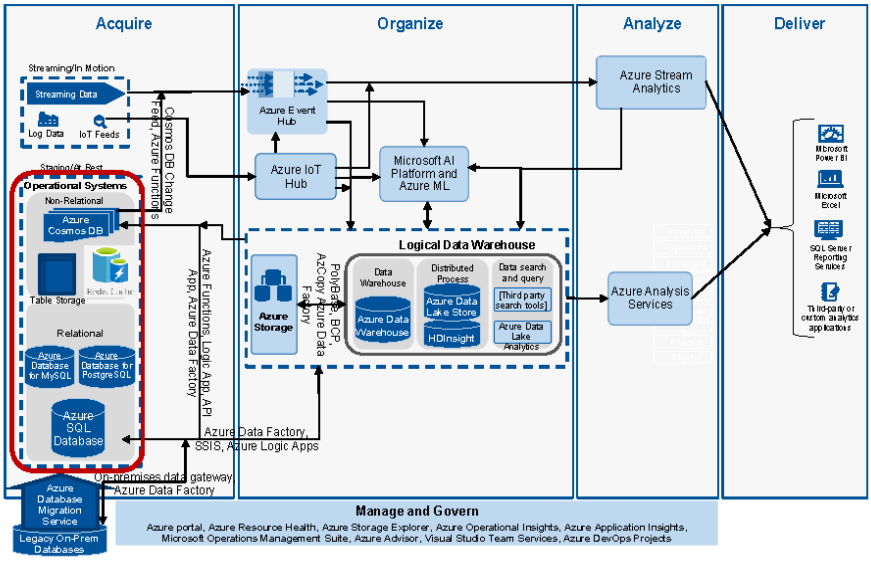
AWS End-to-End Data and Analytics Architecture

dbPaaS



Azure End-to-End Data and Analytics Architecture

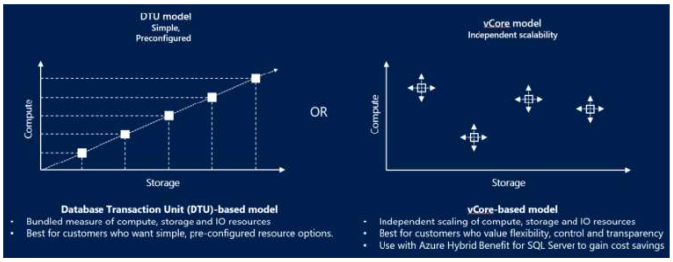
dbPaaS



- Database tools in the cloud scale bigger.

Cloud Database Pricing

- Can be difficult to predict, but is efficient once established:
  - Amazon DynamoDB and Azure Cosmos DB are priced based on preprovisioned throughput for reads and writes.
  - Relational database servers are based on storage and compute

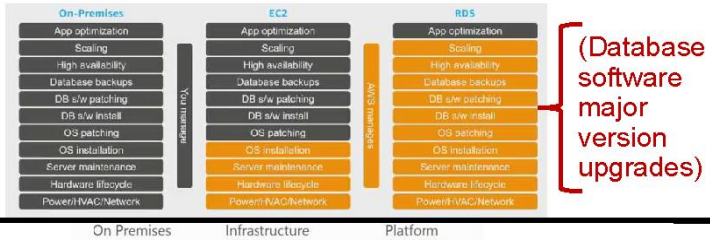


Source: "Azure SQL Database Purchasing Models and Resources," Microsoft Azure

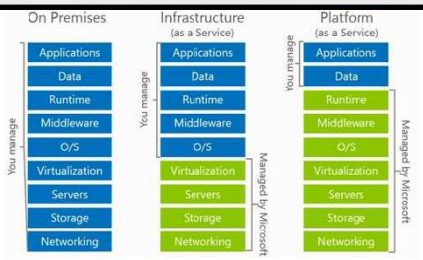
Gartner

The Benefits of dbPaaS

AWS



Azure



Gartner

Managed Private Cloud

- Azure on-premises offerings:
  - SQL Server Stretch Database
  - SQL Server Data Files in Azure
  - Azure Stack with SQL Server
- Oracle Cloud on-premises offerings:
  - Oracle Cloud at Customer with Oracle Database
- AWS and Google:
  - No similar offerings

Migrating Databases From On-Premises to the Cloud

- Amazon RDS databases are not 100% compatible with their on-premises counterparts:
  - No access to server one which the database is running, no access to certain system tables.
- Azure SQL Database is not 100% compatible with Microsoft SQL Server:
  - SQL Server Managed Instance, when it is released, will provide a smoother option, and will be suitable for many but not all migrations.
- Hence, every database migration is a **project.**

Migrating Databases From On-Premises to the Cloud

- Oracle has database offerings on Oracle Cloud that are 100% compatible with their on-premises counterparts:
  - Oracle Database Cloud Service — Bare Metal.
  - Oracle Database Exadata Cloud Service.
  - Oracle Database Exadata Cloud at Customer.
- Oracle is currently building out their cloud platform.

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Gartner

- Gartner recommends making cloud the default deployment option for enterprise database systems.
  - Justify any databases that remain on-premise
  - Perform new development in the cloud
  - Migrate legacy on-premises databases to dbPaaS where feasible
- Focus DBA's on:
  - Solution architecture
  - Performance optimization
  - Database DevOps
  - Security and compliance
  - Researching and development with new data-related technologies
- Adopt a multi-vendor approach to mitigate concerns of cloud vendor lock-in
  - Use a primary cloud vendor for a majority of workloads
  - Use a second cloud vendor as an alternative
  - Consider Azure if yours is primarily a Microsoft shop
  - Explore AWS for moving diverse technology to the cloud

User population identity is exploding, including Bots acting on behalf of human users.

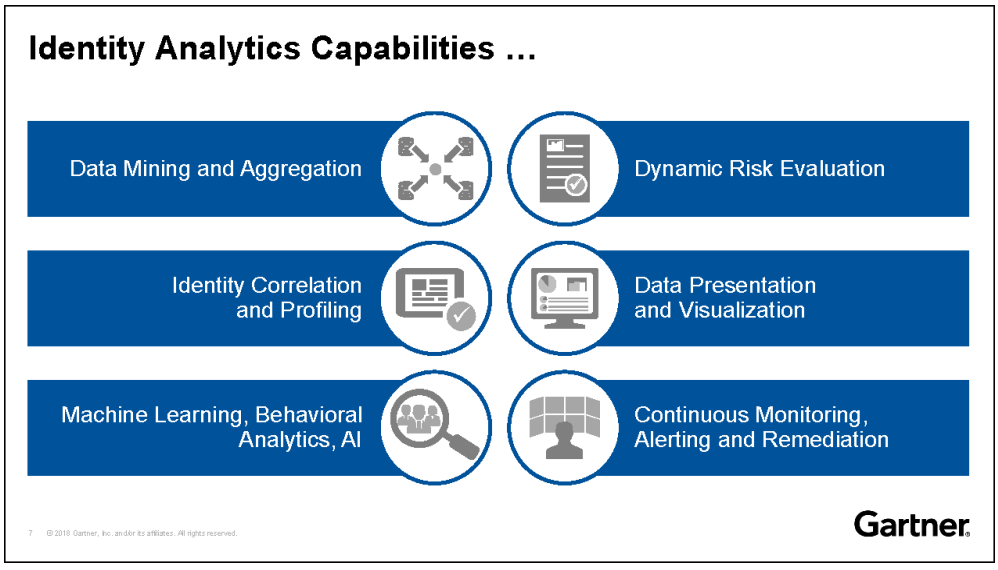
Identity Analytics

How Analytics, Machine Learning, and Artificial Intelligence (AI) are shaping the Future of IAM

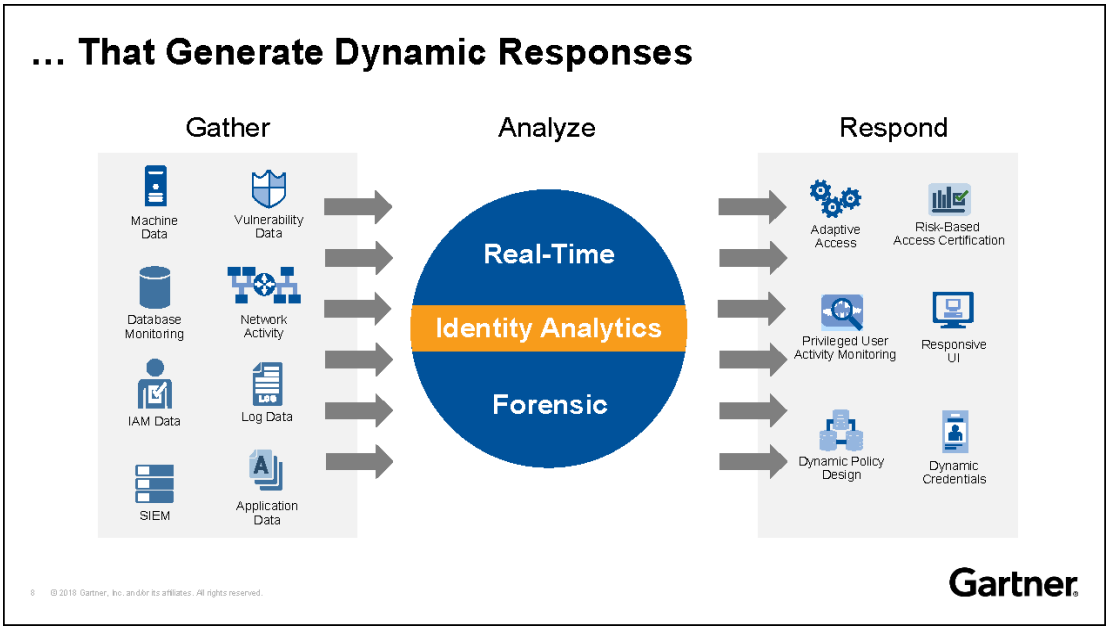
Overview

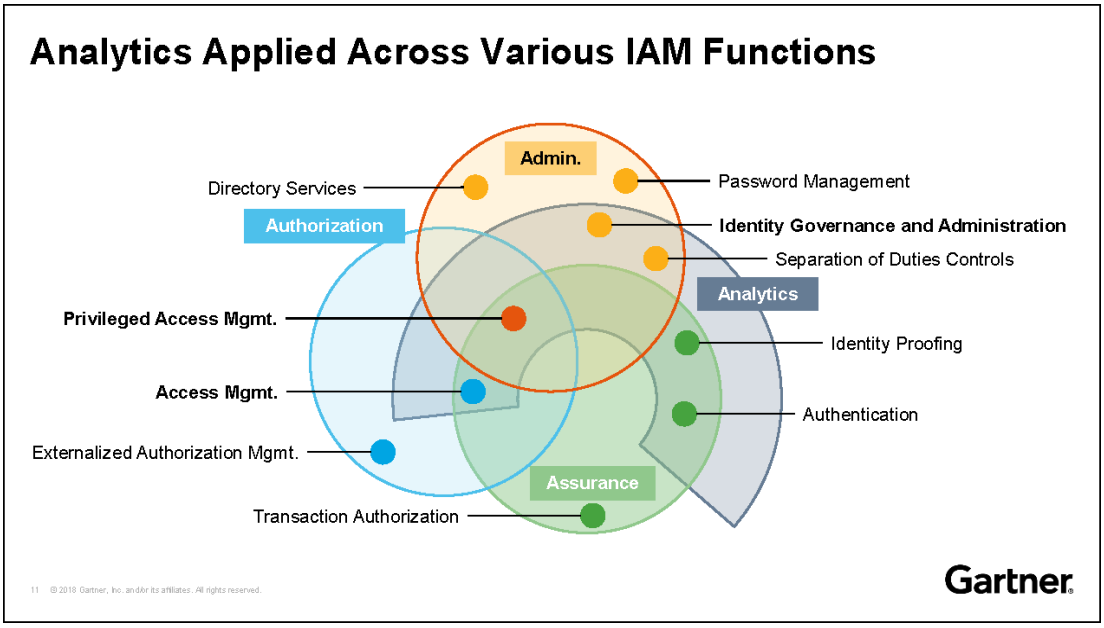
Research and presentation by Ms. Lori Robinson of Gartner.

- Unable to keep up with the attacks.
- 90% of breaches are thru privileged access.



Most IAM innovation is coming from machine learning and behavioral analysis.





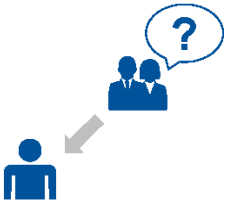
Orthodox Authentication Methods (FIPS Pub 41)

Type 1: Something (only) the person *knows*

- Costly to Support
- Easily Compromised
- Frustrating

- Privacy Concerns
- Presentation Attacks
- Enrolment

Type 3. Something (only) the person *is*



Type 2: Something (only) the person *has*

- Costly to Acquire
- Costly to Provision
- Inconvenient

FIPS: Federal Information Processing Standards

Gartner

Trusted Identity Capabilities Model (TICM)

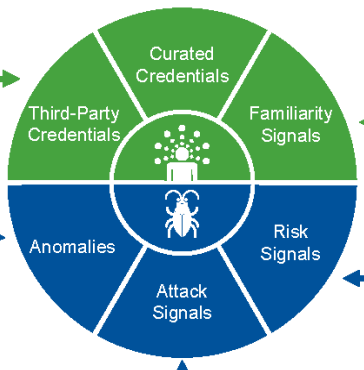
Identity Corroboration

Third-Party Credentials:
Physical:
- National ID Card
- Driving License
- Payment Card

Digital:
- Social Login
- BankID
- GSMA Mobile Connect

Anomalies:
- Other Deviations From Normal Behaviors

Attack Signs:
- Device Spoofing
- Nonhuman Behavior
- Attacker-Like Behavior
- Probing



Curated Credentials:
Orthodox Authentication Methods:
- Passwords
- Tokens
- Active Biometric Models

Familiarity Signals:
- Trusted Device, Location
- Entity Link Analysis
- Social Footprint
- Normal Behaviors
- Passive Biometric Models

Risk Signals:
- Malware Detection
- Short Phone/Email Lifetime
- Anonymity
- Location Mismatch

Identity Dissonance

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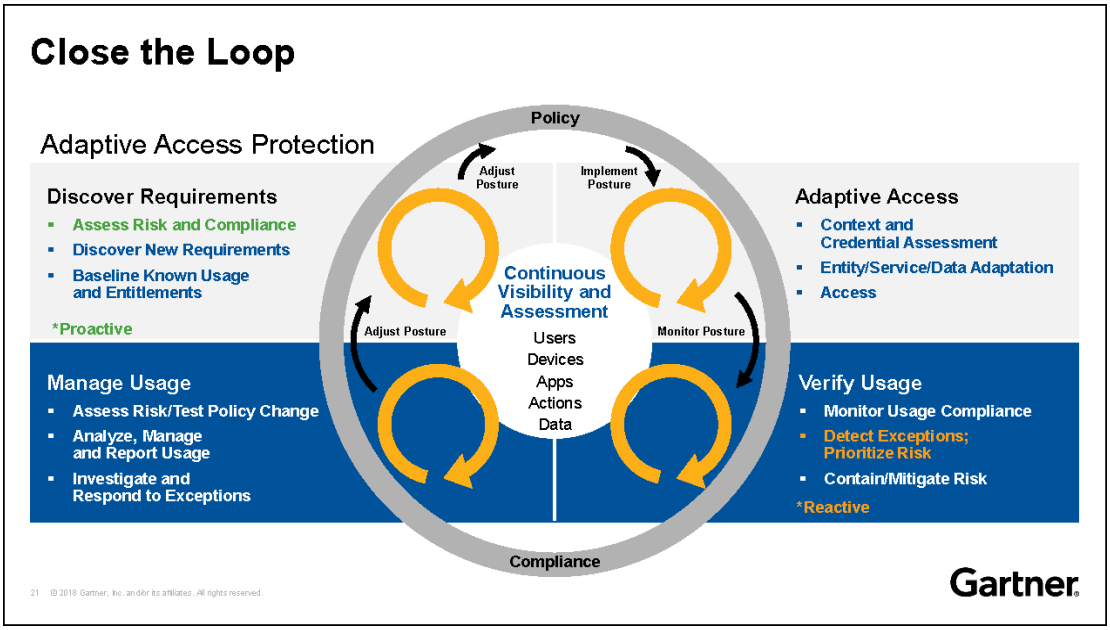
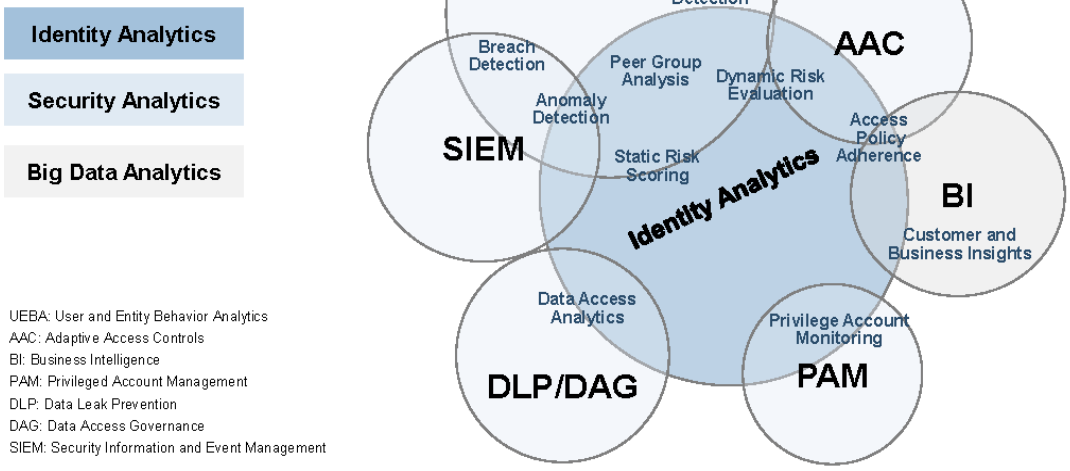
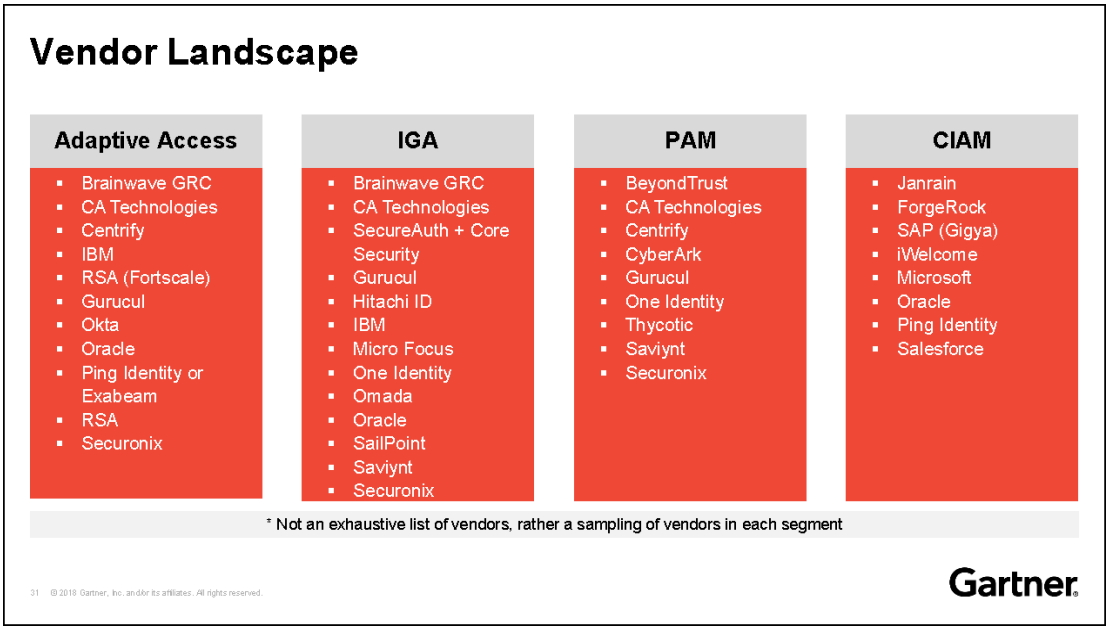
Analytics help achieve effective and continuous IAM.





UEBA: User and Entity Behavior Analytics
AAC: Adaptive Access Controls
BI: Business Intelligence
PAM: Privileged Account Management
DLP: Data Leak Prevention
DAG: Data Access Governance
SIEM: Security Information and Event Management



- Give strong consideration to implementing identity analytics if your organization meets one or more of the following criteria:
    - Is a large, regulated organization that has embraced a risk-based approach to IAM.
    - Relies on one-time allow/deny gating for user authentication.
    - Understands that advanced IAM reporting is insufficient and desires risk-aware, continuous monitoring.
    - Experiences access certification fatigue.
    - Encounters widespread assignment of excessive privileges.
    - Has high usage of privileged access.
    - Suspects the presence of abandoned or orphaned accounts.
    - Has general gaps in security analytic infrastructure and experience with analytic tools.
- Document use cases before selecting a vendor.
- Look for vendors that incorporate machine learning / behavior analytics.
- Analytics is bridging the gap between ID and access controls.
- Real power of IAM is aggregation from other sources.
- Analytics methods are emerging.
- IAM = Admin, Author, and Assurance groups/disciplines – analytics spans all three.

- Adaptive access is the most mature IAM area.
- ID proofing hard in a digital world.
- Governance = Develop policy and verify policies are followed.

Document your cloud strategy.

Cloud Native Strategies

Developing Cloud Native Strategies and Architectures

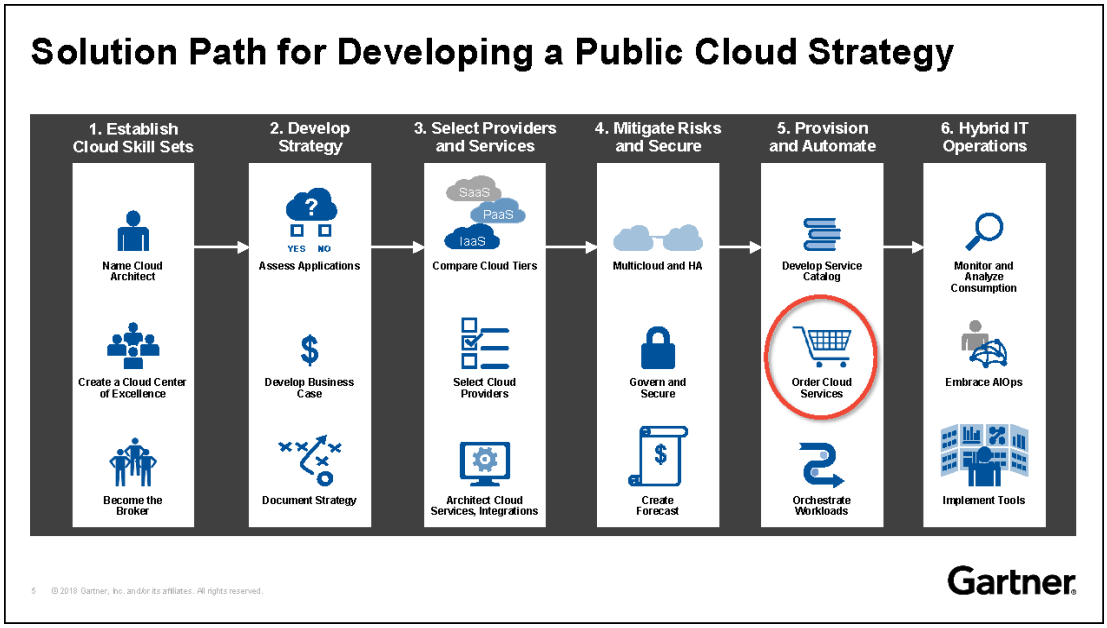
Overview

Research and presentation by Mr. Simon Richard of Gartner.

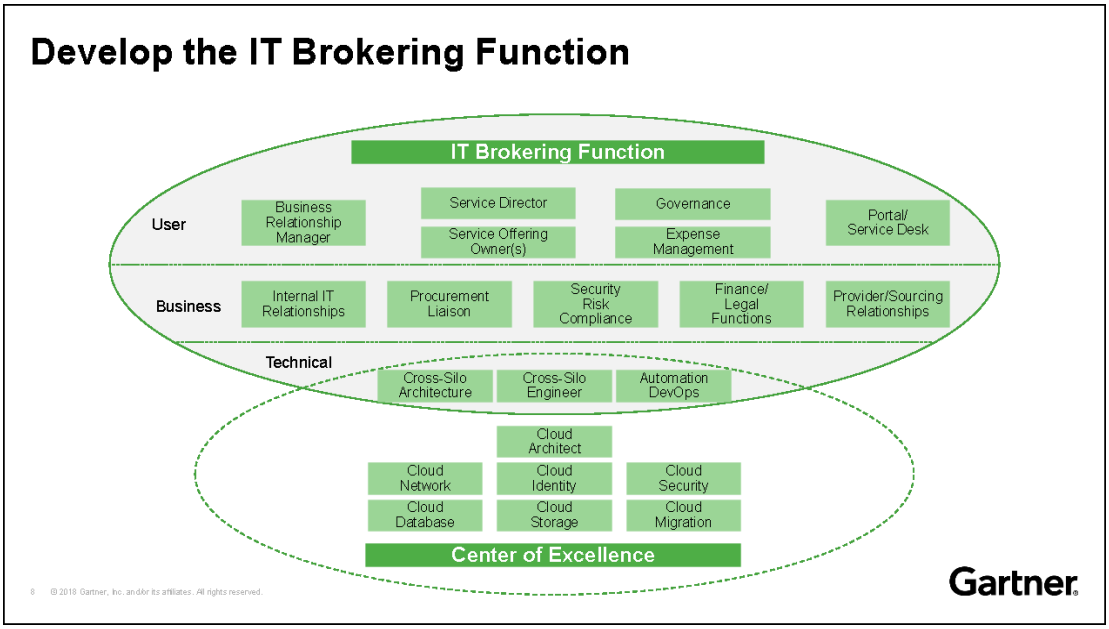
- What it looked like when first heading to the cloud:

- What the road to cloud looks like today:

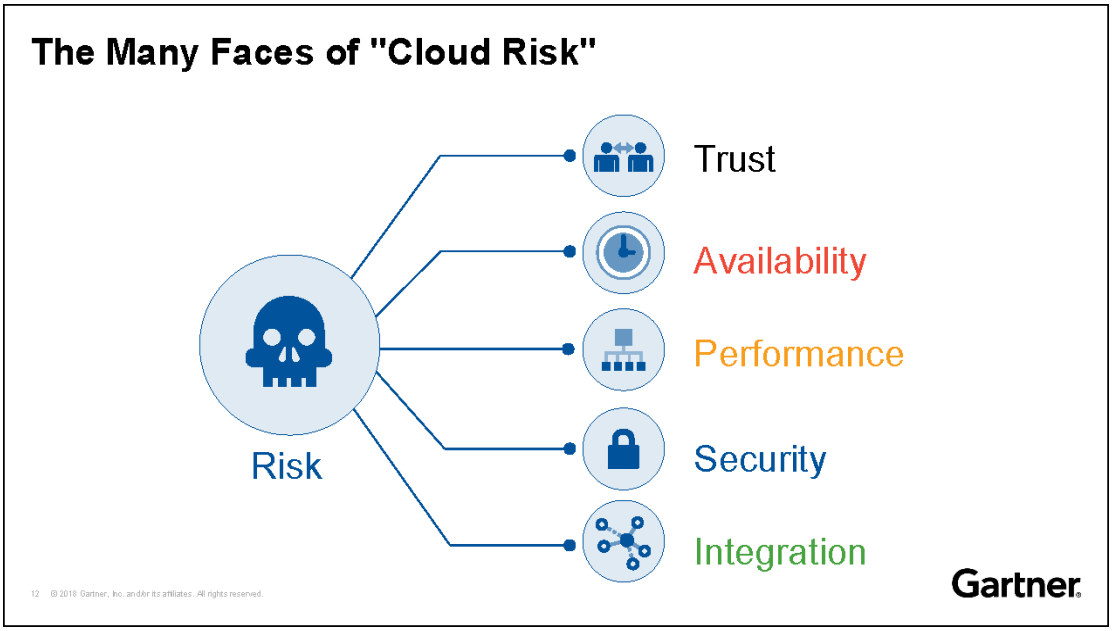
- Develop cloud strategy: Assess applications based on risk, benefits, and effort, then balance all three against the feasibility.
- Expect disruption caused by cloud analytics.

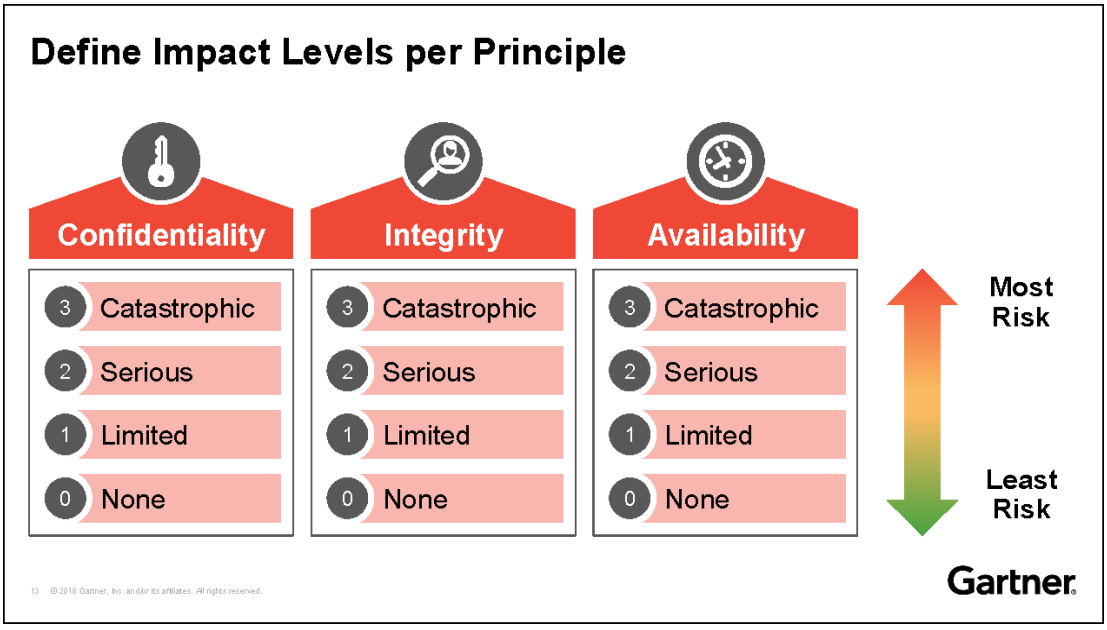


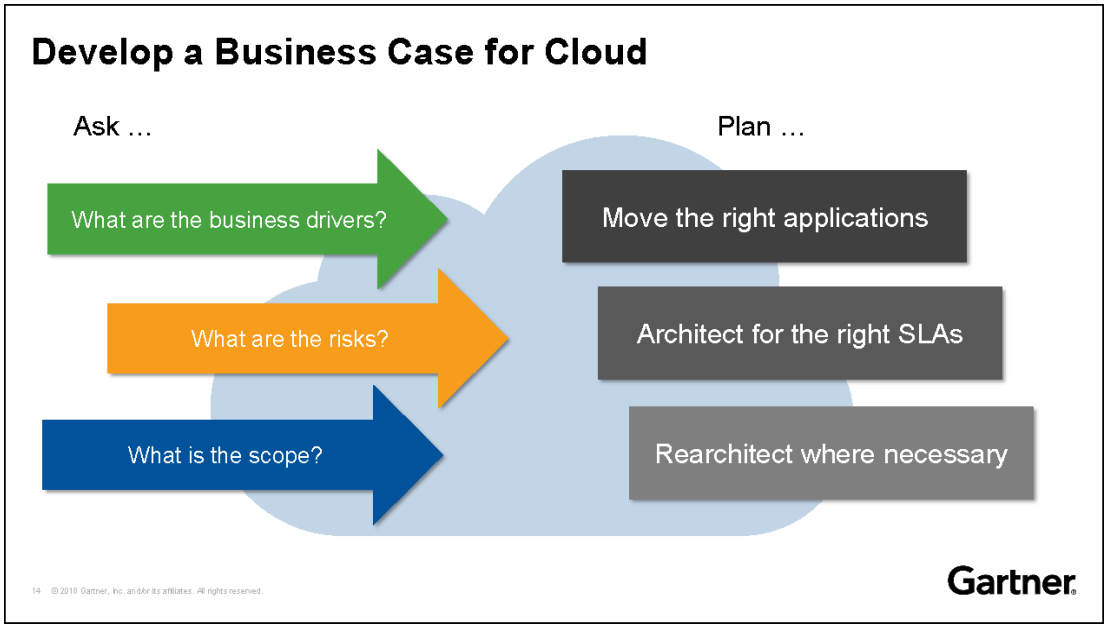
- Establish cloud skill sets: Develop the IT brokering function



By 2020, organizations that lack cost optimization processes will average 40% overspend in the public cloud.






Develop a Business Case for Cloud
Ask …
Plan …
What are the business drivers?
What are the risks?
What is the scope?
Move the right applications
Architect for the right SLAs
Rearchitect where necessary
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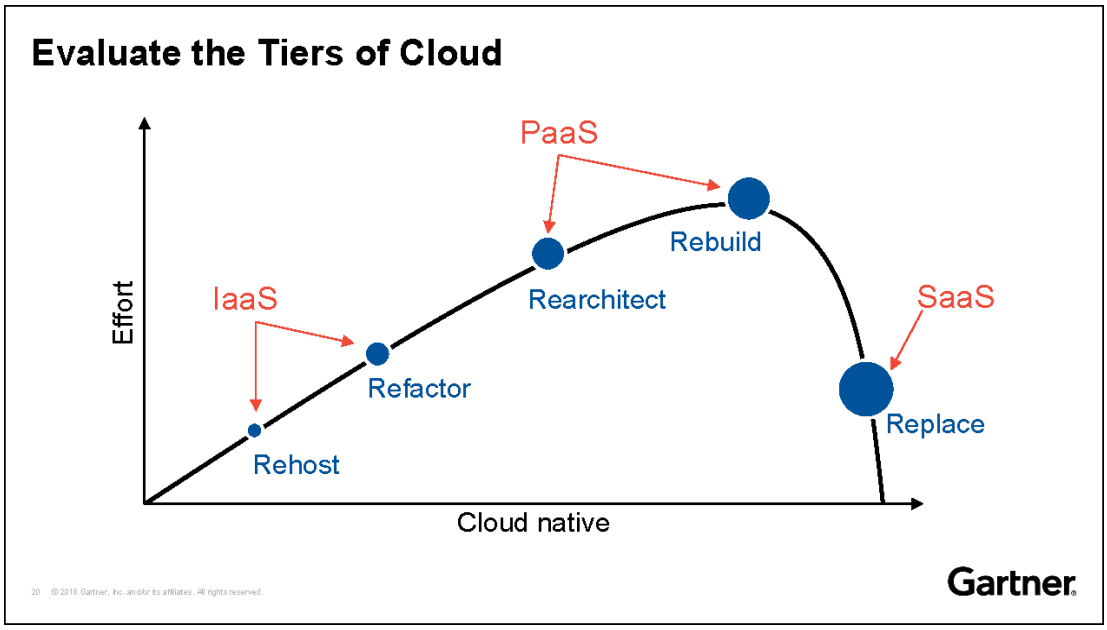
Evaluate the Tiers of Cloud
PaaS
Rebuild
Rearchitect
IaaS
SaaS
Refactor
Replace
Rehost
Effort
Cloud native
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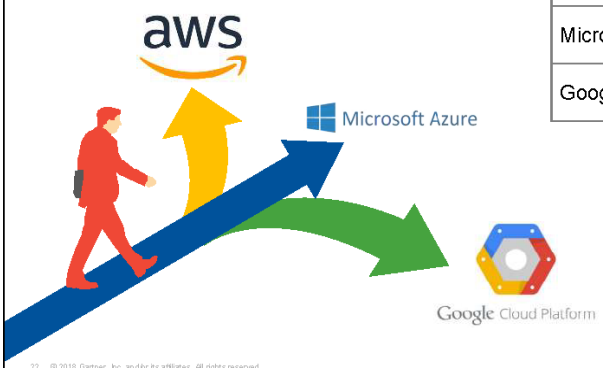
Architect for availability in the cloud.

Compare and Select Providers Based on Technical Capabilities

IaaS Provider	2016	2017	2018
Amazon Web Services	92%	94%	93%
Microsoft Azure	88%	93%	95%
Google Cloud Platform	70%	80%	85%



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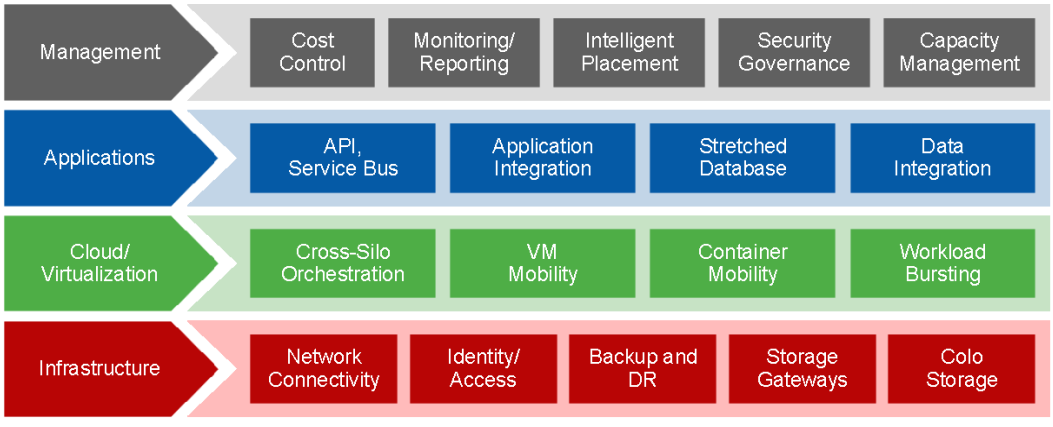
Integration Happens at Different Levels



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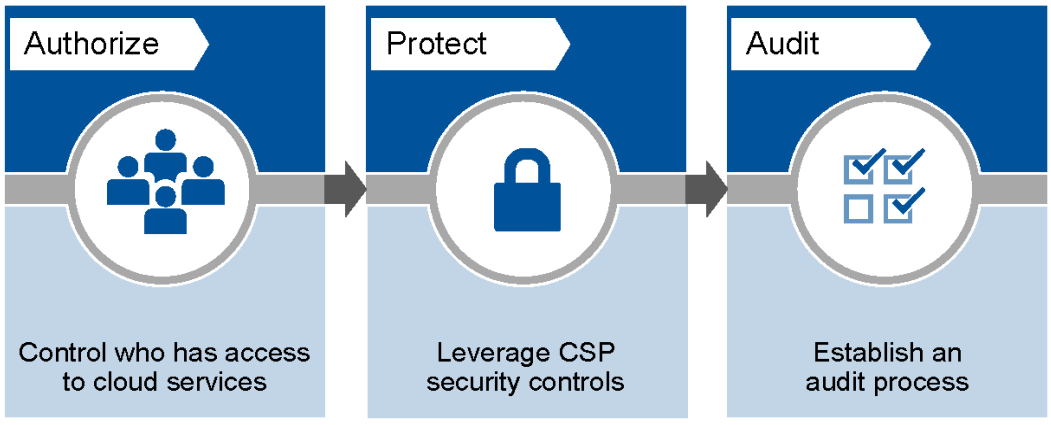
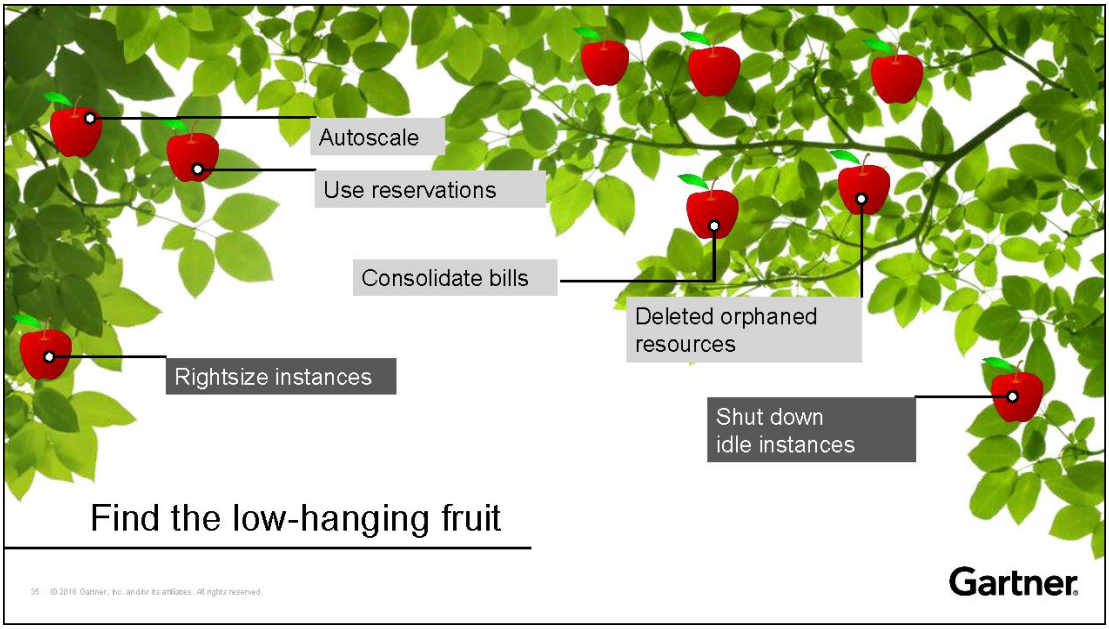
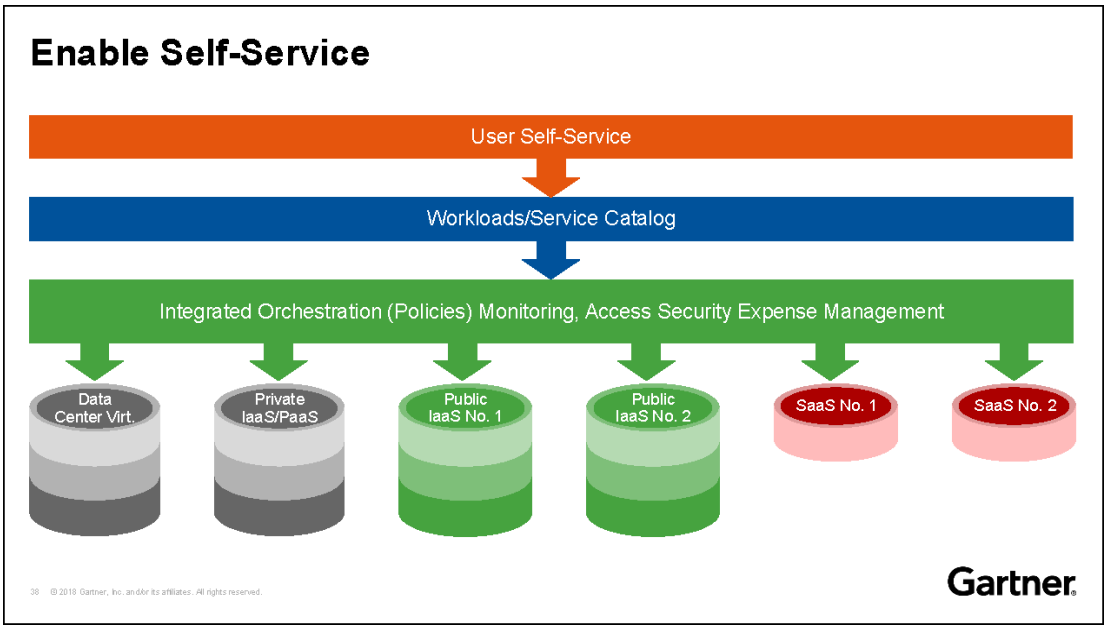
Why Must We Design for Multicloud?

Architect to Secure and Mitigate Risks

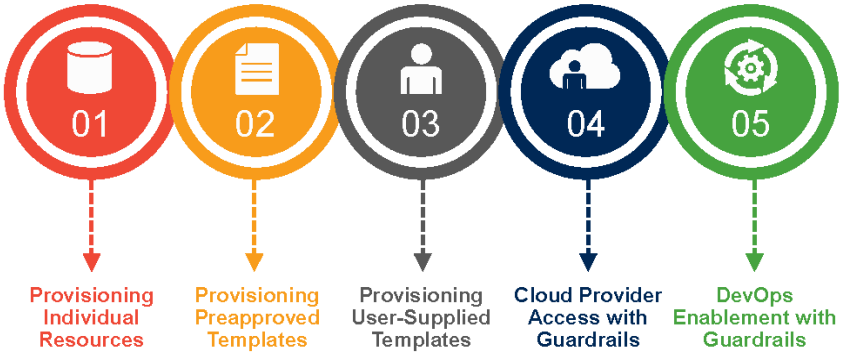


Automating broken processes only breaks things faster!

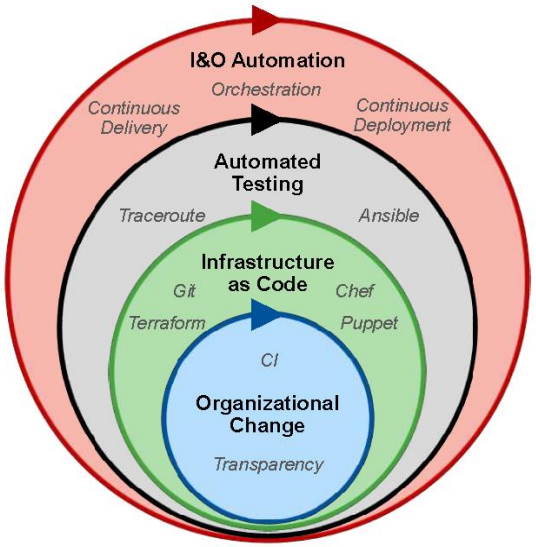




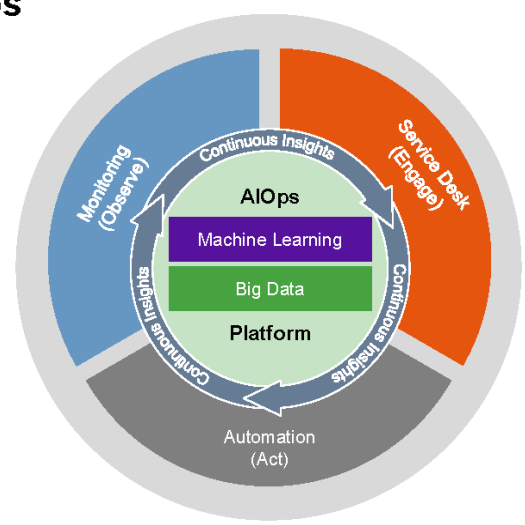
Five Self-Service Approaches



The Automation and Orchestration Cycle



Embrace AIOps



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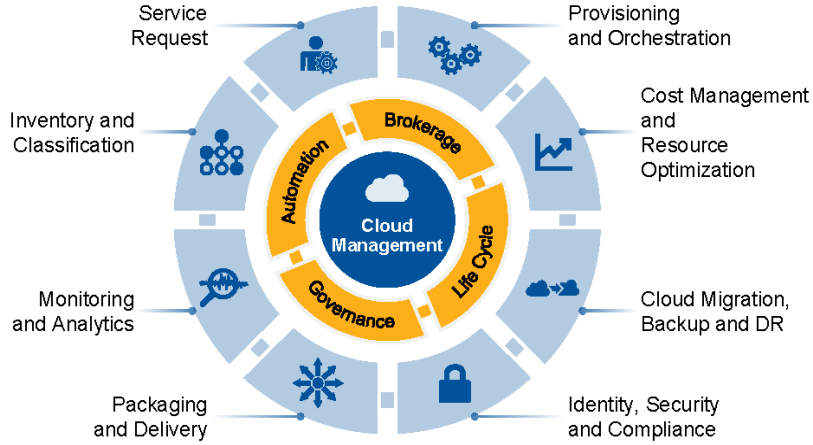
The Cloud Management Wheel



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"Got something very important to point out to your readers? Use a sidebar to make it stand out."

IoT and Gartner Reference Model

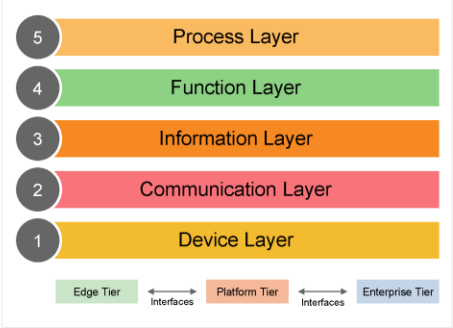
Architect the Internet of Things (IoT) Using the Gartner Reference Model

Overview

Research and presentation by Mr. Kyle Hilgendorf of Gartner.

The Gartner IoT Reference Model: Layers, Tiers and Interfaces

- **Tiers** define **where** a component, function or process operates in the IoT architecture.
- **Layers** define **what** behavior an IoT component, function or process must possess.
- **Interfaces** define how data and control **flow** into, out of and through the system.



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Reference Model Tiers Define Logical Deployment Locations

Edge Tier	Platform Tier	Enterprise Tier
▪ Physical/Digital interface ▪ Local ingestion/analysis ▪ Local/Distributed ▪ Sensors and actuators	▪ Global ingestion/analysis ▪ Event processing ▪ Policy and orchestration ▪ Algorithms and applications	▪ Business systems ▪ Workflow processes ▪ IT services ▪ Operations

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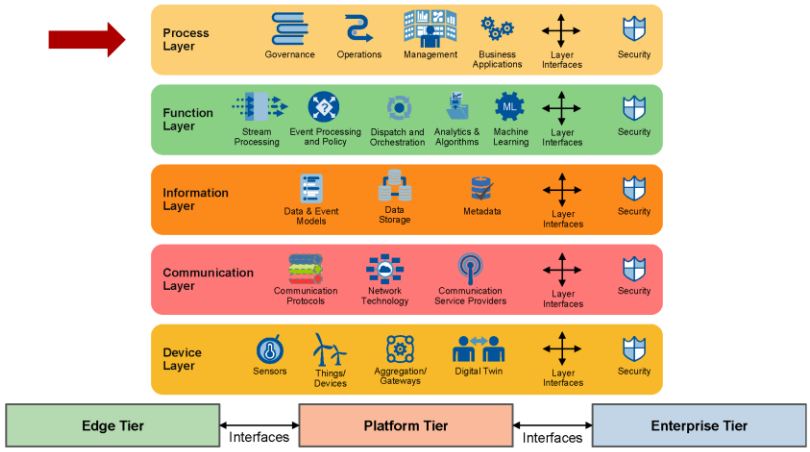
Reference Model: Process Layer



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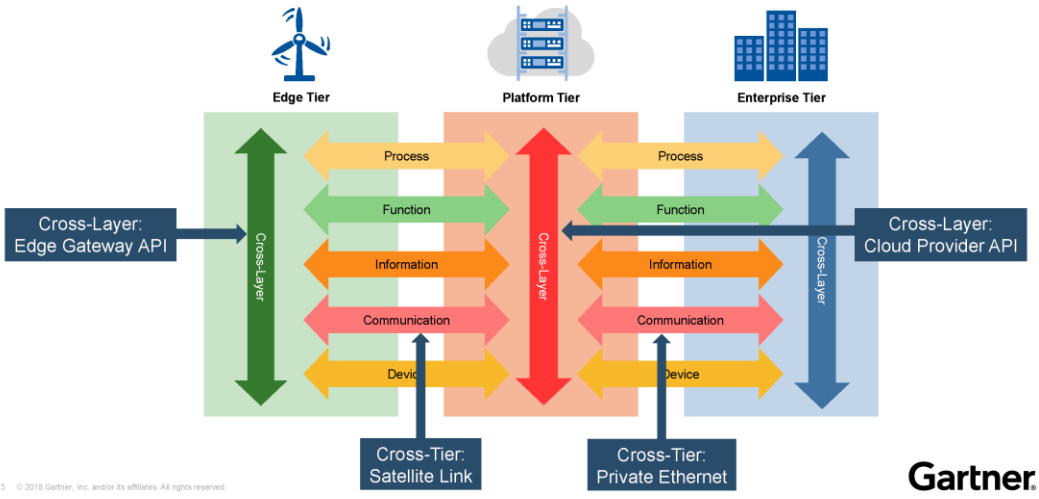
Cross-Tier and Cross-Layer Interfaces



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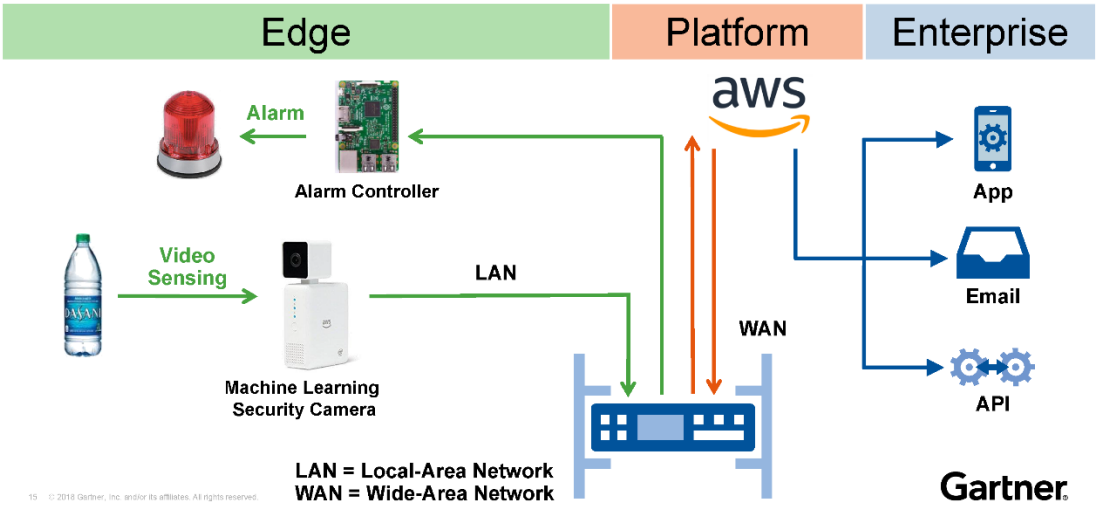
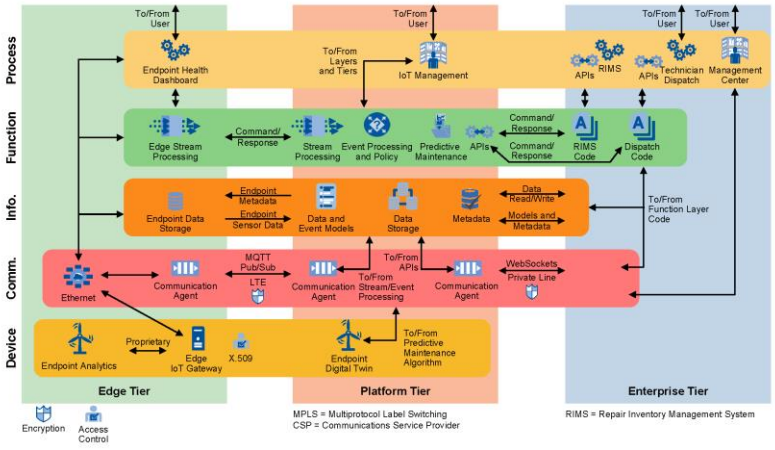
IoT and Gartner Reference Model

Architect your IoT system using the Gartner IoT reference model – decompose complexity using layers, tiers, and interfaces.

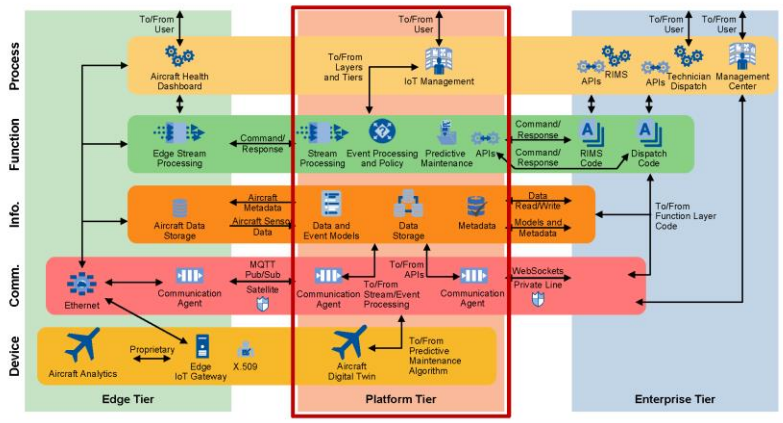
Machine Learning Quality Control Demo



Putting It All Together: Predictive Maintenance Architecture Blueprint

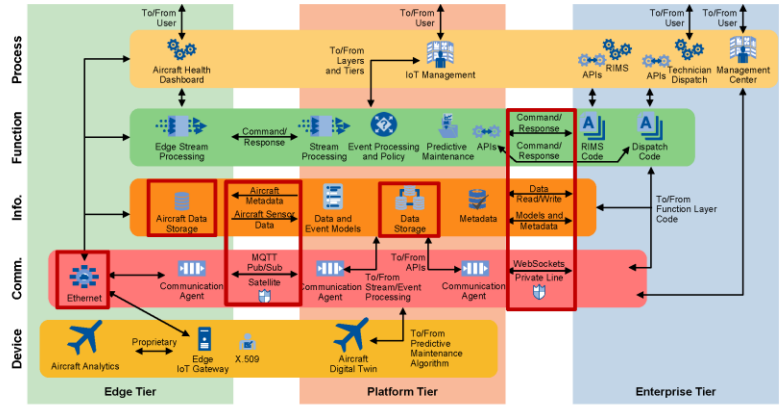


Finance Team Collaboration



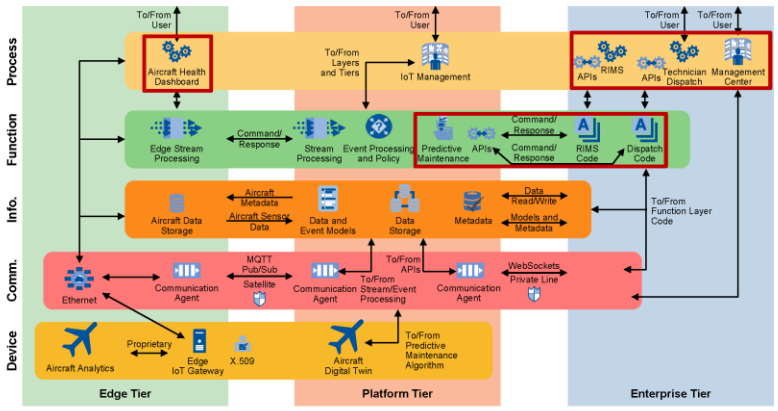
Outcome: Analysis of how the IoT cloud platform will impact operational cost.

Security Team Collaboration



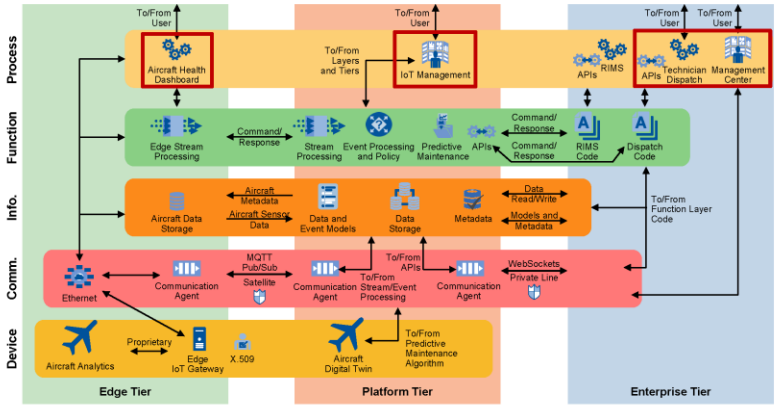
Outcome: Increased awareness, communication and analysis of security risks.

Application Development Team Collaboration



Outcome: Improved software integration with end-to-end architecture.

Operations and Governance Teams Collaboration

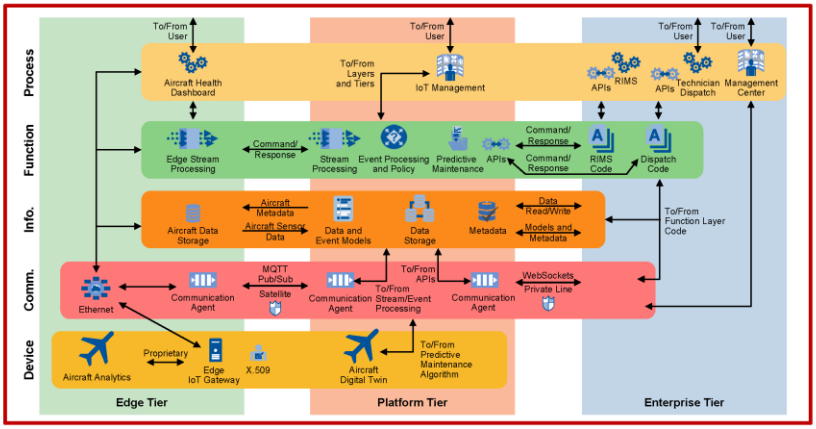


Outcome: Better system operation and project governance.

IoT and Gartner Reference Model

Use your cloud model/blueprint to collaborate with stakeholders while iteratively refining the blueprint based upon stakeholder feedback.

Systems Engineering Team Collaboration



Outcome: Enhanced overall experience and improved business outcomes.

- Edge tier is where physical meets digital.
- http://bit.ly/iotrefmodel

Basic Premises

Devices
send and receive data interacting with the
Network
where the data is transmitted, normalized, and filtered using
Edge Computing
before landing in
Data storage / Databases
accessible by
Applications
which process it and provide it to people who will
Act and Collaborate

Standards based approaches are required to enable the IoT industry

Building the Internet of Things (IoT) – Cisco

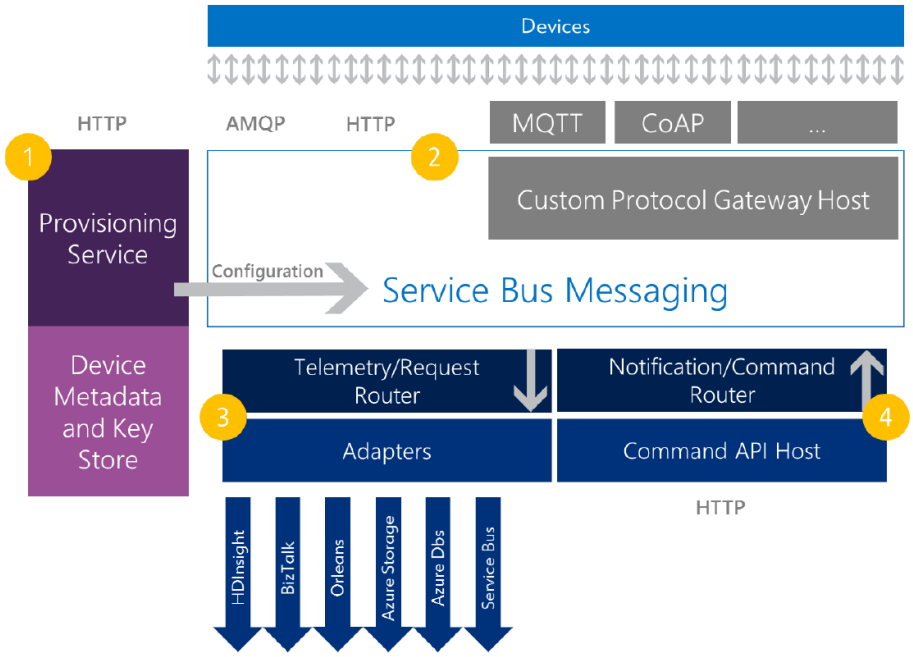


Figure 14. Reference architecture conceptual overview

Internet of Things (IoT) Conceptual Architecture Model – Microsoft

Self service capability is a huge driver.

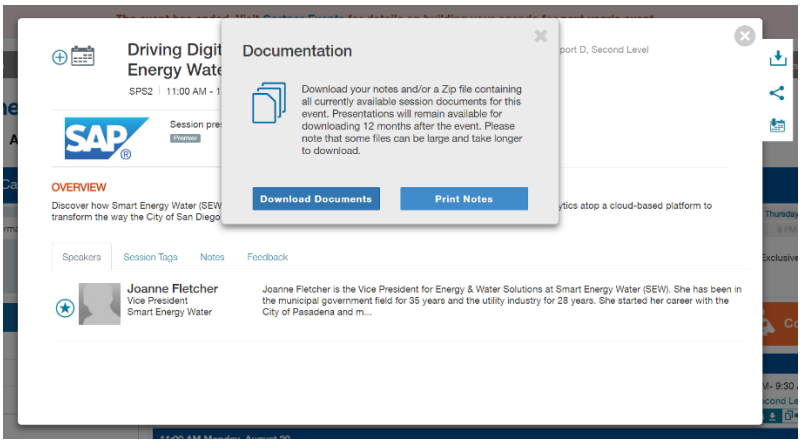
UTO – Digital Transformation

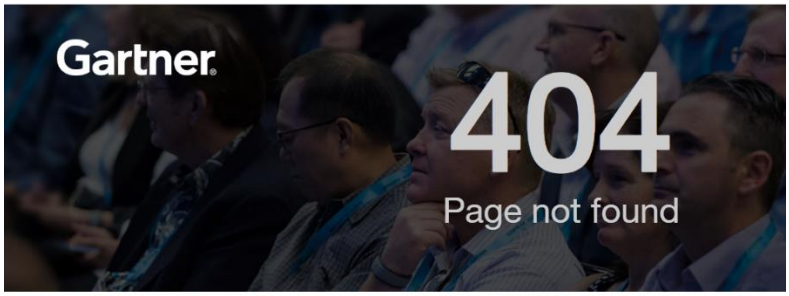
Driving Digital Transformation with Intelligent Technologies

Overview

Research and presentation by Ms. Joanne Fletcher of the City of San Diego.

Unable to obtain (UTO) presentation deck through reasonable efforts.





Sorry, we can't find the page or file you are looking for

If you typed the address, try double-checking your spelling

If you followed a link from somewhere, please let us know and we will do our best to fix it

If you are stuck, here are other options

View all Gartner events

Microstrategy helps to turn the culture in an organization.

UTO – Disparate Data

Rubber Meets the Road: Driving Insights from Disparate Data

Overview

Research and presentation by Mr. Cameron Forbes of Falken Tire.

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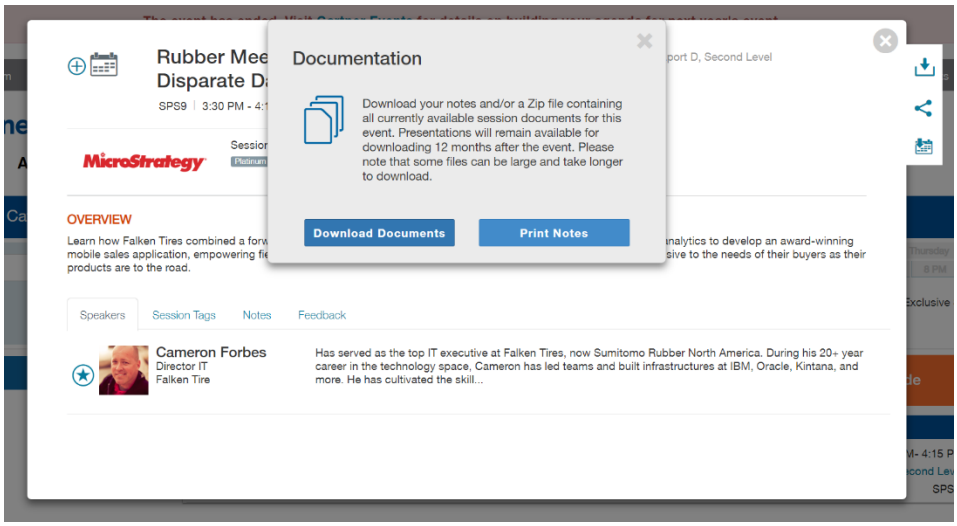


Security is still high on delaying to cloud.

Do not necessarily get rid of your on-premise solution.

There is risk for data in motion to / from the cloud, and on data at rest in the cloud.

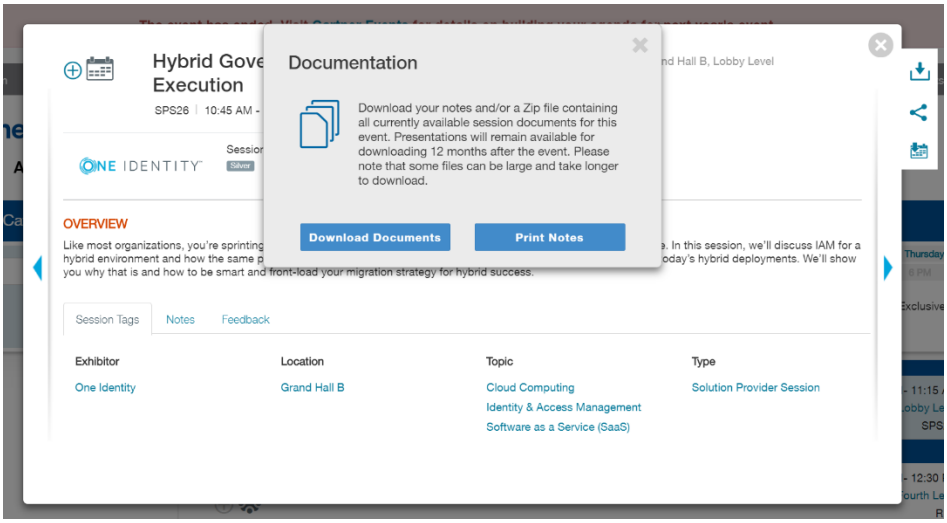
UTO – Hybrid Governance

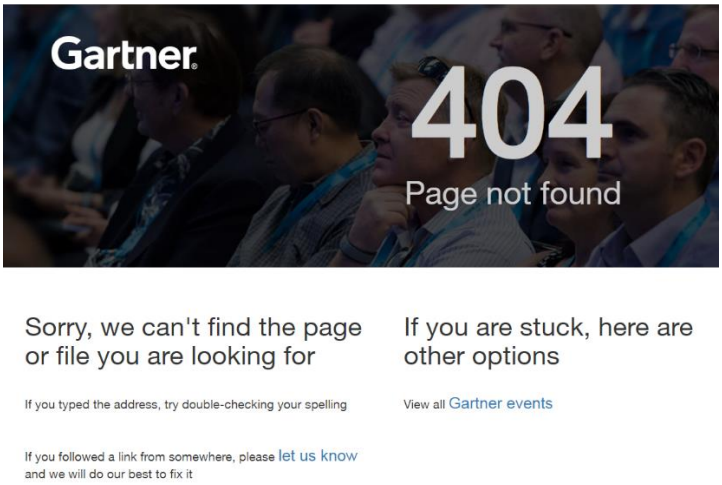
Hybrid Governance Demands Hybrid Execution

Overview

Research and presentation by One Identity.

Unable to obtain (UTO) presentation deck through reasonable efforts.





She believes the solution for the IT talent shortage is more women.

She identified herself several times as a feminist with a capital “F”.

Just because you failed does not mean you should not try anymore.

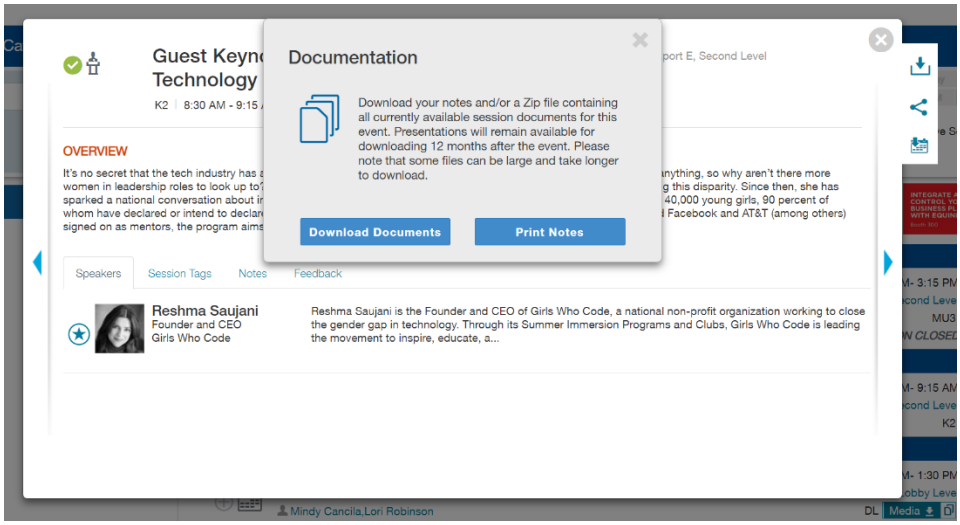
UTO – IT Gender Gap

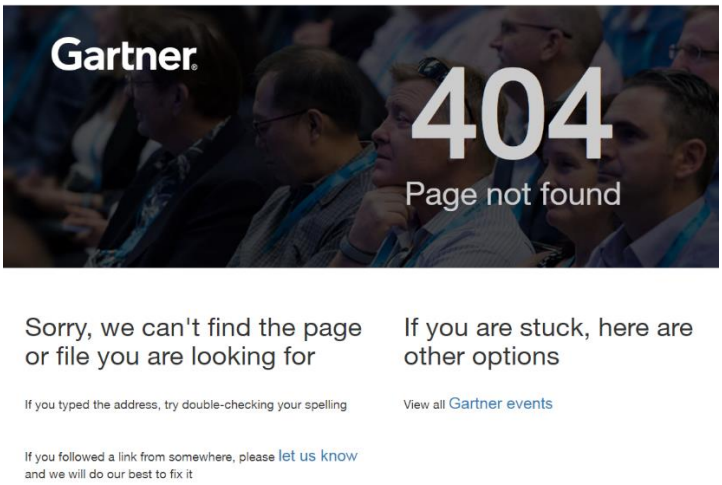
Closing the Gender Gap in IT

Overview

Research and presentation by Ms. Reshma Saujani, Founder and CEO of Girls Who Code.

Unable to obtain (UTO) presentation deck through reasonable efforts.





How do you monitor / manage microservices when they're up for less than a minute?

30% of microservices fit this situation…

UTO – VMware

The VMware That You Might (Not) Know

Overview

Research and presentation by Mr. Cameron Haight of VMware.

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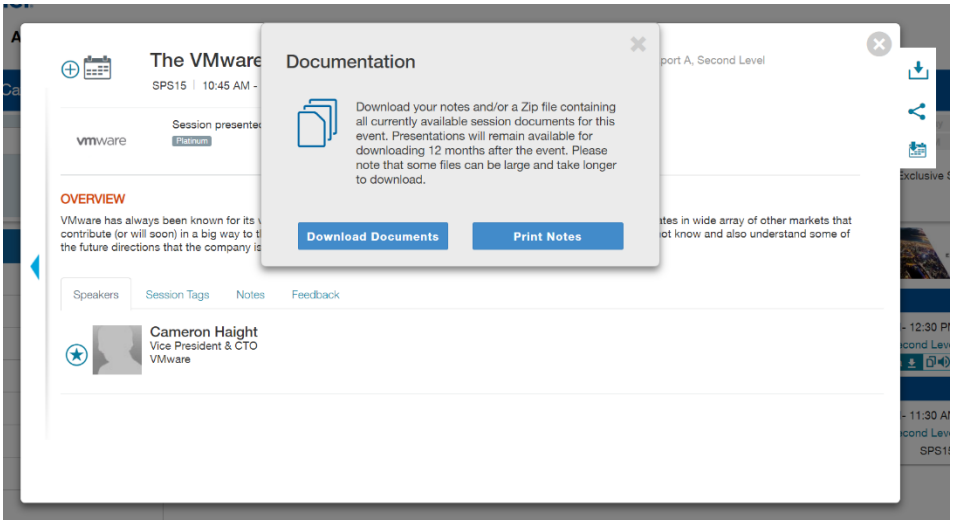

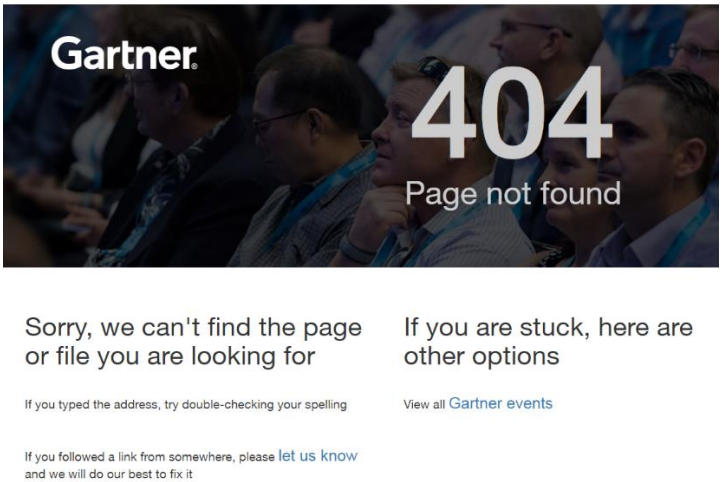

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